

वार्षिक
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क्षेत्रीय अनुसंधान प्रयोगशाला
(वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद्)

जम्मू 180001

Regional Research Laboratory
(Council of Scientific & Industrial Research)
Jammu 180001

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REGIONAL RESEARCH LABORATORY
(Council of Scientific and Industrial Research)

Jammu 180 001

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प्रस्तावना

भारत सरकार ने 1 अप्रैल, 1993 से सरकार द्वारा प्राप्त धन से निर्मित होने वाले भवनों में लकड़ी के प्रयोग पर पूर्ण प्रतिबन्ध लगा दिया, जिसके फलस्वरूप इसके वैकल्पिक साधनों की प्रबल खोज का कार्य तुरन्त ही आरम्भ हुआ। हमारी प्रयोगशाला ने इस सन्दर्भ में दो विकल्प प्रस्तुत किए हैं जो निम्नलिखित हैं:-

- (अ) सम्पूर्ण भारत में जंगली पैदावार के रूप में उगने वाले *लैन्टाना कैमरा* और *सैक्करम् मुन्जा* (सरकंडा) से निर्मित मिश्र एवं संकर बोर्ड (तख्ता)।
- (ब) नारियल जटा व खड़िया मिट्टी का तख्ता (कॉयर जिप्सम बोर्ड)। दिल्ली के केन्द्रीय लोक निर्माण विभाग (सी. पी. डब्ल्यू. डी) द्वारा एक दरवाजा वाली विभाजीय दीवार का निर्माण किया गया और इसे प्रदर्शन हेतु रखा गया है।

ये दोनों विकल्प के. लो. नि. वि. (सी. पी. डब्ल्यू. डी.) के कड़े परीक्षणों के आधीन हैं। इनसे प्राप्त परिणामों के आधार पर इन दोनों उत्पादों का पुनः सुधार किया जा सकेगा। जम्मू की मुख्य प्रयोगशाला, इसकी श्रीनगर शाखा एवं पालमपुर विस्तार केन्द्र में गत वर्षों के मध्य बहुमुखी शोध और विकास के लिए अपनायी गयी गतिविधियों को चार वर्गों में प्रस्तुत किया गया है जो निम्नलिखित हैं:-

1. हमारी अनुसंधान परिषद् द्वारा अनुमोदित परियोजनायें
2. अन्य अनुसंधान एवं विकास परियोजनायें
3. संरचना सुविधायें और
4. शेष संग्रहित शोधकार्य (उपांग)

अनुसंधान एवं विकास गतिविधियों का प्रमुख बल आर्थिक उन्नति से सम्बन्धित अनुसंधान और विकास कार्यों को दिया गया है। इसके अतिरिक्त प्रयोगात्मक कार्यों से उत्पन्न कुछ मूल समस्याओं को हल करने का कार्य भी हाथ में लिया गया। विभिन्न गतिविधियों की प्रगति का विवरण समुचित शीर्षों के अन्तर्गत दिया गया है। लेकिन काष्ठ विकल्पों के अतिरिक्त कुछ अन्य मुख्य गतिविधियों का संक्षिप्त विवरण इस प्रकार है :-

1. "टर्न की कार्य":- विश्वस्तरीय संविदा के अनुरूप क्षेत्रीय अनुसंधान प्रयोगशाला, जम्मू ने यूनिडो, वियाना से वियतनाम में एक बहुददेशीय रसायन सुगन्धित निर्माण वाला

अभिकल्प स्थापित करने के लिए एक संविदा प्राप्त की। इस अभिकल्प का खाका और ढाँचा क्षेत्रीय अनुसंधान प्रयोगशाला, जम्मू में बनाया गया और इसका निर्माण अब पूर्ण होने को है। हमारे वैज्ञानिक तथा अभियन्ता अप्रैल-मई 1993 को इसे वियतनाम में स्थापित कर चालू करेंगे। सिन्कोना तथा अन्य औषधीय पादपों के निदेशालय के लिए 16 डी. पी. ए. के उत्पादन हेतु एक “टर्न की” कार्य भी पूर्ण कर लिया गया है। यह अभिकल्प गैरिबस (जिला दार्जिलिंग, पश्चिमी बंगाल) में जुलाई 1992 से आरम्भ किया गया।

2. *प्रक्रिया विकास* :- एनीसॉल और एसीटोफिनोन से औषधि *p*-मेथाक्सी फैनिल एसीटिक अम्ल 56% तक उत्पन्न करने की प्रक्रिया का विकास किया गया। आयोडीन और बेन्जीन से 80% उत्पादन क्षमता में आयोडोबेन्जीन बनाने की प्रक्रिया भी विकसित की गई। इसकी उत्पादन क्षमता 90% तक बढ़ाने के प्रयास किए जा रहे हैं।

3. *औषधि विकास* :- भेषजीय सूत्र एटी-3, जिसमें जैवीय उपलब्धता वर्धक घटक आर. एल. जे. एन. ई.-210 है, का भेषजीय परीक्षण संकलित करके भारत सरकार के औषधि नियन्त्रक (डी. सी. आई.) को प्रेषित किया गया है। द्वितीय चरण में रोगी व्यक्तियों पर भेषजीय परीक्षणों की स्वीकृति भी प्राप्त कर ली गयी है। प्रथम चरण (फेज-1) के भेषज सूत्र की प्रारम्भिक व्याख्या संकलित करके डी. सी. आई. को भेजी गयी है। पादप संकेत संख्या 5101 से विघटित अंश आर. एल. जे. एन. ई.-299ए का प्रयोगाधीन चूहों पर अत्यन्त प्रभावकारी प्रतिरक्षाकारी एवं पौष्टिकता वर्धक प्रभाव पाया गया है। अत्यधिक साधारण व बहुतायत से प्रयुक्त होने वाले (कीमों इम्यूनोसप्रेसिव) कर्कट प्रतिरक्षा एवं पौष्टिकता निषेधक घटकों जैसे कि एजॉथिओप्रिन, साइक्लो-फास्फामाइड और बीटा मेथासोन का इस विघटित अंश ने प्रबल प्रतिकार किया है। इस विघटित अंश का 6 माह तक मौखिक सेवन करने से चूहों के सामान्य व्यवहार, विकासदर, रोवों (फर) के रूप और रंग में काफी सुधार हुआ है।

4. *लाभकारी पादप* (आर्थिक लाभ वाले पादप) :- *आसिमम कैनम* की एक नई किस्म (जिसके तेल में 70% से अधिक लिनालूल पाया गया है) का विकास, हमारे अनुसंधान केन्द्र और कृषकों के खेतों में विस्तृत कृषि परीक्षणों के पश्चात् किया गया है। इसका क्षेत्र. अं. प्र., जम्मू के स्थापना दिवस पर औपचारिक विमोचन किया गया। *आसिमम* और सिम्बोपोगॉन की विभिन्न प्रजातियों की अनेक अन्य किस्मों का कार्य, विकास की विभिन्न अवस्थाओं पर हैं।

इस कार्यक्रम का उद्देश्य प्रति इकाई क्षेत्र में अधिक शस्यता और अधिक तेल उत्पादन विकसित करना है। इसके अतिरिक्त मुख्य रूप से, व्यवसायिक रूप से उपलब्ध सिट्रल, जिरेनियॉल तथा यूजीनॉल के साथ-साथ वांछित एलिमेसिन, मिथाइल सिन्नामेट, फारनिसॉल और α -बिसाबोलॉल जैसे नये घटकों का विस्तार व अनुसंधान करना भी है। ऐसे ही प्रयास फसलों की पूर्ण अन्तःशक्ति के अनुसंधान हेतु कृषि प्रौद्योगिकी के विकास के लिए भी किए

गए हैं। हिमाचल प्रदेश में हापस की विभिन्न किस्मों के भिन्न-भिन्न स्थानों पर उगाने के प्रयास भी जारी हैं। हिमाचल प्रदेश के दूर-दराज़ के क्षेत्रों में, पिछड़े वर्गों की आर्थिक स्थिति को सुधारने के साथ-साथ निकट भविष्य में हापस की खेती की व्यवसायिक सफलता भी संभावित है।

5. *फसलोपरान्त प्रौद्योगिकी*:- जंगली खट्टे अनार (अनारदाना बनाने के लिए प्रयुक्त होने वाले) के छिलकों से बीजों/गूदे को अलग करने वाले एक यंत्र (मशीन) का विकास किया गया और यह जम्मू प्रान्त के अनारदाना उत्पादन करने वाले क्षेत्रों में परीक्षण हेतु दिखाई गयी। इस यन्त्र की जंगली प्रजाति के अनार की विधायन क्षमता 30 किग्रा. और खाद्य योग्य (स्थानीय) प्रजाति के अनार की विधायन क्षमता 60 किग्रा. प्रति घंटा है। यह अनारदाना उत्पादकों की उत्पादकता को पर्याप्त बढ़ा सकेगा। अनारदाना पर आधारित बहुत से उत्पादों का विकास किया गया है। भण्डारण तथा डिब्बाबन्दी की अवस्थाओं में सुधार करके इसकी संरक्षण अवधि तथा ताक जीवन को भी मानकीकृत किया गया है।

रेशम कीट पालन:- रेशम कीट पालन के कृत्रिम भोजन के विकास की दिशा में एक प्रयास में स्थानीय कच्चे माल से कुछ नुस्खे (सूत्र) तैयार किए गए और इनकी तुलना शहतूत की पत्तियों और जापानी कृत्रिम खुराक से की गयी। अध्ययनों द्वारा ज्ञात हुआ है कि इनमें से एक नुस्खा जापानी खुराक से भी श्रेष्ठ है।

सम्मान:- हमारी प्रयोगशाला के दो वैज्ञानिक भारत की एसेंशियल आयल्स एसोसिएशन के सदस्य निर्वाचित हुये हैं तथा दो वैज्ञानिकों को पी. एच. डी. की डिग्री हेतु अनुसंधान के लिए पर्यवेक्षक के रूप में मान्यता प्राप्त हुई है।

प्रकाशन और एकस्वअधिकारी पत्र:- हमारी प्रयोगशाला के वैज्ञानिकों के दो समीक्षा लेख और अनुसंधान पत्र प्रकाशित हुये हैं। उन्होंने संगोष्ठियों/परिसंवादों में भी अनेक लेख प्रस्तुत किये। इस रिपोर्ट की अवधि के दौरान पांच एकस्वअधिकारी पत्र भी दाखिल किये गये।

प्रशिक्षण एवं प्रदर्शन:- टमाटर, नींबू जाति के फल, खुम्बों की खेती और विधायन, उन्नत जलजीव संवर्धन विधियाँ, सजावटी मछली के पालन और हापस की खेती के संरक्षण पर प्रशिक्षण कार्यक्रम आयोजित किए गए। पिलानी स्थित बिरला के प्रौद्योगिकी एवं विज्ञान संस्थान के अभियांत्रिकी के विभिन्न शिक्षणों के अध्ययनरत दस पूर्वस्नातक छात्रों को दो माह का प्रायोगिक प्रशिक्षण दिया गया।

अन्य गतिविधियाँ:- सिम्बोपोगॉन पर टेब परियोजना की बैठक का आयोजन क्षेत्रीय अनुसंधान प्रयोगशाला, जम्मू ने किया, जिसमें केन्द्रीय औषध एवं सुगन्ध पादप संस्थान, लखनऊ, क्षेत्रीय अनुसंधान प्रयोगशाला, भुवनेश्वर और हमारी प्रयोगशाला के तत्सम्बन्धी वैज्ञानिकों ने भाग लिया। वैज्ञानिक एवं औद्योगिक अनुसंधान परिषद् स्थापना दिवस का,

सी. एस. आई. आर. के स्वर्ण जयन्ती समारोह के साथ वर्ष भर के समापन समारोह के रूप में भी आयोजन किया गया।

सभी स्टाफ-सदस्यों में विशेष स्मृति चिन्ह भी वितरित किये गये और सेवानिवृत्त कर्मचारियों तथा वैज्ञानिक एवं औद्योगिक अनुसंधान परिषद् में अपना तीस वर्ष का सेवाकाल सम्पूर्ण कर चुके सभी कर्मचारियों को प्रथागत स्मृति चिन्ह भेंट किये गये। समारोह का मुख्य आकर्षण अनारदाना विधायन मशीन का उद्घाटन समारोह था। प्रथानुसार क्षेत्रीय अनुसंधान प्रयोगशाला के स्थापना दिवस प्रथम दिसम्बर '92 को मनाया गया। मुख्य अतिथि, डॉ. एस. वरदाराजन के विशेष भाषण और उनके द्वारा लिनालूल के “ऑसिमम केनम” की उन्नत प्रजाति के विमोचन के साथ ही समारोह सम्पन्न हुआ। राष्ट्रीय एकता सप्ताह का आयोजन 19 से 25 नवम्बर '92 को किया गया।

प्रयोगशाला के निदेशक एवं स्टाफ सदस्यों ने अध्यक्ष तथा अनुसंधान परिषद् एवं प्रबन्ध परिषद् के सदस्यों को अनुसंधान एवं विकास कार्यक्रमों के आयोजन तथा निष्पादन में उनके द्वारा दिये गये महत्वपूर्ण निर्देशन एवं सहयोग के लिए धन्यवाद दिया।

INTRODUCTION

The Govt. of India decided to ban use of wood completely in construction of government funded buildings with effect from 1st April, 1993. Thus a desperate search started immediately for alternative materials. Our Laboratory offered following two alternatives.

a) Composite and hybrid boards made from *Lantana camara* and *Saccharum munja* (Sarkanda) both growing wild throughout India.

b) Coir - gypsum boards made from gypsum and coir fibre. A partition wall with doors has been constructed in Central Public Works Department (CPWD) office in New Delhi and kept for demonstration.

Both these substitutes are presently under rigorous trials by CPWD. Further improvements on the basis of feed back received are being made in both the products. As per the style followed during the last few years the multidisciplinary R&D activities of the main Laboratory at Jammu, its Branch at Srinagar and Extension Centre at Palampur are presented under four groups, namely (i) Projects approved by our Research Council, (ii) Other R&D Projects/ investigations, (iii) Infrastructure, and (iv) Appendices. While major thrust of R&D activities was on applied research and extension work related to economic development, fundamental work was also undertaken to solve some of the basic problems originating from applied work. Details of various activities and progress achieved are mentioned under appropriate heads, but some salient activities other than wood substitutes stated above are mentioned briefly hereunder:

Turn-key jobs

A contract from UNIDO, Vienna was bagged by RRL, Jammu against global tenders to set up a multi-purpose aroma chemical plant at Vietnam. The plant was designed and fabricated in RRL, Jammu and is nearing completion. It will be installed and commissioned at Vietnam in April-May, 1993 by our scientists and engineers. A turn-key job for production of 16-DPA has been completed for Directorate of Cinchona and other Medicinal Plants. The plant was commissioned at Gairibas (District Darjeeling-West Bengal) in July 1992.

Process Development

A process for preparation of drug intermediate *p*-methoxy phenylacetic acid from anisole and acetophenone has been developed with

56% yield. Efforts are now being made to increase the yield to 65%. A process has also been developed for preparation of iodobenzene from iodine and benzene with 80% yield. Efforts are now being made to increase the yield to 90%.

Drug Development

Phase-I clinical trial data on formulation AT-3 containing bioavailability enhancer compound RLJ-NE-210 has been compiled and submitted to Drug Controller of India (DCI). Permission for Phase-II clinical trials has been granted. Preliminary dossier on the formulation AT-1 has been compiled and submitted to DCI. Permission for Phase-I clinical trials has been granted.

Fraction RLJ-NE-299A (isolated from plant coded 5101) has shown potent immunorestorative effect in experimental animals. The fraction counteracted the immune suppression induced by most common clinically used chemo-immunosuppressive agents (*i.e.* azathioprine, cyclo-phosphamide and betamethasone). Oral administration of the fraction for six months improved the general behaviour, growth rate, appearance and fur colour in rats.

Economic Plants

A newly evolved variety of *Ocimum canum*, the oil of which contains over 70% linalool, after extensive agronomic trials in our research farm and cultivator's field was formally released on RRL-Jammu Foundation Day. Many other varieties evolved from different species of *Ocimum* and *Cymbopogon* are at various stages of development. The objective of this programme is to develop strains with higher herbage and oil yield per unit area, predominance of desired new constituents like elemicin, methyl cinnamate, farnesol and α -bisabolol in these oils in addition to improvement in content of commercially exploited constituents like citral, geraniol and eugenol. Simultaneous efforts are also made to develop improved agrotechnology of these crops for exploitation of their full potential. Effort was also continued to grow different varieties of hops in various locations in Himachal Pradesh. Hops is likely to be commercial success in near future besides improving the economic condition of rural people in far flung areas of Himachal Pradesh.

Post-harvest Technology

A mechanical device for separating arils from skins in case of wild sour pomegranate (used for making '*Anardana*') has been developed and released for field trials in *Anardana* producing areas of Jammu province.

The machine has the capacity to process 30 kg of wild variety and 60 kg of table variety of pomegranate per hour. The machine will greatly improve the efficiency of 'Anardana' producers. Many anardana based products have been developed. The storage and packing conditions to improve the shelf life have also been standardized.

Sericulture

In an effort to develop artificial diet for rearing of silkworm, certain formulations were prepared from local raw materials and compared with mulberry leaf and Japanese artificial diet. Studies have shown that one of the formulations is even superior to Japanese diet.

Honour

Two scientists of our Institute have been elected as members of Essential Oil Association of India and two scientists have been approved supervisors to guide research leading to the award of Ph.D.degree.

Publications & Patents

Two review articles and fifty six research papers were published by our scientists. They also presented number of articles at symposia/seminars. Five patents were also filed during the period of this report.

Training and Demonstration

Training programmes were organised on preservation of tomatoes, citrus, cultivation & processing of mushrooms, improved aquaculture techniques, rearing of ornamental fish, and cultivation of hops.

A two-month practical training was imparted in different disciplines of engineering to ten undergraduate engineering students of Birla Institute of Technology and Science, Pilani.

Other Activities

RRL, Jammu hosted a meeting of the TAB project on *Cymbopogon*, which was attended by scientists of CIMAP, Lucknow, RRL, Bhubaneswar and concerned scientists of our laboratory.

CSIR Foundation Day was celebrated as concluding function of year long Golden Jubilee celebrations of CSIR. Special mementos were distributed to all the staff members and as usual mementos were also given to retired employees and those who completed 30 years of service in CSIR. The highlight of the function was inauguration of Anardana Processing Machine.

RRL Foundation Day was also celebrated as usual on 1st December, 1992. The celebrations included special lecture by Chief Guest Dr.S.Varadarajan and release by him of linalool rich variety of *Ocimum canum*. National Unity Week was celebrated from 19-25 November 1992.

The Director and staff of the Laboratory thank the Chairmen and Members of the Research Council and Management Council for valuable guidance and support given by them in the planning and execution of the R&D programmes.

R&D PROJECTS APPROVED BY RESEARCH COUNCIL

01 DRUGS AND PHARMACEUTICALS

01 RC 01 Hepatoprotective Drugs

(a) *RLJ-NE-451 (043)*

The compound RLJ-NE-451 (043) (1e) which showed maximum activity was isolated in sufficient quantity (8g) using MPLC and column chromatographic techniques. The compound was finally purified by crystallization to yield cream coloured material, m.p. 247-249°C, highly soluble in acetone, methanol and lukewarm water. This compound was biologically evaluated in rats against CCl₄-induced liver injury in doses 50, 100, 200 and 400 mg/kg given orally in single and multi-dose treatment for its curative as well as prophylactic properties on parameters like SGOT, SGPT and bilirubin. It showed significant dose related protection on all the parameters tested both in curative and prophylactic studies. The effect of 50 mg/kg p.o. of silymarin was equivalent to 200 to 400 mg/kg of RLJ-NE-451 (043) (1e).

On the basis of spectral data, the structure of the compound was established and found to be 3,4,5-trihydroxy benzoic acid, *i.e.* gallic acid. However, final identity of the compound, was established by procuring the authentic samples of gallic acid and determination of Co, TLC, MMP, UV, and recording of superimposable IR spectrum.

(b) *RLJ-NE-548 (025)*

This plant coded 025 was taken up to identify its active principle(s) as significant hepatoprotective activity of its 50% alcoholic extract has already been reported by our Laboratory. Fresh dried material after defatting was extracted with 50% methanol and after further processing dark green viscous extract RLJ-NE-548 (025) was obtained. A portion of extract was separated into water soluble and insoluble portion. Water soluble portion was further fractionated with different solvents like chloroform, ethyl acetate, n-butanol and water soluble residue to yield

fractions RLJ-NE-548 (025) (C), (E), (B) and (R). Water insoluble portion was coded RLJ-NE-548(025) (Wi). All these fractions were biologically tested for their hepatoprotective activity against CCl₄-induced toxicity and fractions RLJ-NE-548 (025) (E), (B) and (Wi), showed significant hepatoprotective activity with (Wi) showing the maximum effect. On chemical examination the fraction E and B showed presence of gallic acid and, therefore, further work on isolation of active principle(s) was taken up with fraction RLJ-NE-548 (025) (Wi). It was fractionated with different solvents like, pet. ether, ethyl acetate, methanol and water to obtain RLJ-NE-548(025) (Wi), p, e, m, w & r. The protective effect of all these fractions was evaluated against CCl₄ hepatotoxicity and compared with the parent fraction RLJ-NE-548 (025) (Wi). All these fractions showed activity with RLJ-NE-548 (025) (Wi) (m) showing maximum activity of 72.74%, which had slight edge over the parent fraction with 63.5% activity. RLJ-NE-548 (025) (Wi) (m) was then subjected to further fractionation to get methanol extract lower and upper fractions. On biologically testing these fractions showed 36.45% and 56.01% activity respectively which is much less than the parent material.

01 RC 02 Anti-inflammatory Drugs

(a) Boswellic acids : Phase I Clinical Trials

(i) *Single dose study* : A placebo controlled double blind non-crossover study was carried out on normal healthy volunteers (n=42) to determine the maximum tolerated dose. All the volunteers were subjected to clinical examination covering ECG, various haematological and biochemical tests both before initiation and 24 h after oral drug treatment. Doses of boswellic acids were gradually increased from 100-1500 mg. No significant side effect was recorded.

(ii) *Multiple dose study* : This was aimed to assess any adverse effects produced upon continuous oral administration of boswellic acids over 4 weeks period. All the tests stated above were performed in addition to routine examination for any side or adverse effect. Doses of 500 mg per volunteer (n=10) and 1000 mg/per volunteer (n=10) were used. No significant side effect was recorded.

(iii) *Anti-inflammatory activity .on topical application* : Boswellic acids ointment (3-7%) demonstrated 25-30% AIA on topical application in carrageenan induced oedema in rat paw, and croton oil induced ear oedema in mice.

(iv) *Anti-ulcerogenic effect* : Boswellic acids in a dose range of 250-1000 mg/kg upon single oral administration demonstrated significant protection (60-80%) against HCl and alcohol induced ulcers in rats.

Table 1 : Anti-inflammatory Activity of Eight compounds

Compound	AIA at 100 mg/kg p.o.	
	Carrageenan oedema	Adjuvant arthritis
461 C	-	42
RLJ-NE-547	26	28
RLJ-NE-509 A	-	42
RLJ-NE-509 B	-	37
RLJ-NE-509 C	-	55
RLJ-NE-509 D	-	28
RLJ-NE-522	26	30
RLJ-NE-410	32	34

b) Anti-inflammatory Activity (AIA)

Twenty five different fractions/plant extracts were subjected to anti-inflammatory testing by acute test of carrageenan oedema in rats as well as chronic test model of adjuvant arthritis in rats. Eight compounds showed anti-inflammatory activity (Table 1).

01 RC 03 Immunomodulating Agents***(a) RLJ-NE-299A***

Immunorestorative effect : In continuation to earlier studies the experiments were carried out to find out the effect of RLJ-NE-299A on long term immunosuppression with low doses of cyclophosphamide (Cy) and also to see the discriminatory action of this fraction in cyclophosphamide (Cy), betamethasone (BMS), methotrexate (MTX) and azathioprine (Aza treated animals).

RLJ-NE-299A has shown significant immunorestorative effect in rats treated with low doses (2.5-10 mg/kg x 21 days) of Cy. While Cy produced 33.33% and 11.16% reduction at 5 mg and 2.5 mg/kg p.o. doses respectively, oral administration of RLJ-NE-299A (12.5 mg/kg) for 5 days-post-immunization alongwith Cy was not only able to restore the antibody synthesis to normal level but also increased the titres by 33.33% and 95.83% in Cy (5 and 2.5 mg/kg) treated groups when compared to normal control and 100% and 120.45% respectively as compared to Cy treated control. All the animals treated with 10 mg/kg Cy did not survive the test.

RLJ-NE-299A (12.5 mg/kg/d p.o.) displayed better protection (131.25% increase) against BMS induced suppression than against Cy (90.90% increase in antibody titre). The effect of 12.5 mg/kg 299A against Cy (10 mg/kg/d x 20 days) and BMS (250 µg/kg/day x 20 days) was comparable to that of levamisole (2.5 mg/kg p.o.).

Post-immunization administration of RLJ-NE-299A (12.5 mg/kg/d p.o.) for 5 days demonstrated greater effect on antibody synthesis in rats immunosuppressed with Cy, BMS or Aza than on simultaneous administration of drug alongwith above immunosuppressive agents for 15 days prior to immunization. It showed no appreciable effect against MTX (2.5 mg/kg/d x 15 days) induced immune suppression.

General Pharmacology : RLJ-NE-299A in 100-1000 mg/kg p.o. or i.p. doses produced no CNS stimulant or depressant effect in rats and mice. It exhibited no analgesic, autonomic or neuromuscular signs except mild writhing at 300-1000 mg/kg doses.

Acute toxicity : The LD₅₀ was determined to be 2360±57.61 (F.L. 2247.09-2472.91) mg/kg i.p. in mice and 2166.25±62.23 (F.L. 2064.24-2308.22) mg/kg i.p. in rats. The oral LD₅₀ was found to be greater than 2500 mg/kg in rats and mice.

Chronic toxicity : Six months oral feeding of RLJ-NE-299A at 25, 50 and 100 mg/kg doses produced no significant change in the general behaviour, growth rate or appearance of fur at 25 and 100 mg/kg doses in rats. However, signs of diarrhoea, desipation and general weakness were seen in rats, treated with 50 mg/kg dose. It produced no significant change in haematological or biochemical parameters and macroscopic appearance of internal organs.

Reproductive studies : RLJ-NE-299A has shown no antifertility activity and teratogenicity (F2 generation) at 25-100 mg/kg doses in rats.

Diuretic activity : Single dose oral administration of RLJ-NE-299A at 200, 100 and 50 mg/kg in rats showed 37.06%, 25.53% and 11.60% antidiuretic activity respectively.

(b) Immunomodulatory activity of some plant extracts/fractions

RLJ-NE-216 : RLJ-NE-216 (6.25-25 mg/kg/d x 7 days p.o.) produced 16-254% increase in plaque forming cell (PFC) in normal mice and 87%, 70% and 9.67% when it was administered along with BMS, MTX and Cy respectively. It enhanced the humoral antibody synthesis in response to SRBC in normal mice but showed less marked effect in animals treated with BMS, MTX or Cy. It showed slight inhibitory effect on DTH in normal and BMS, MTX or Cy treated mice.

Boswellic acids (BA) : BA (25-200 mg/kg p.o.) enhanced the humoral immune response in rats and mice and inhibited the cell mediated immunity in mice. It did not significantly alter the immunosuppressive effect of BMS.

RLJ-NE-370 : RLJ-NE-370 significantly enhanced the antibody synthesis in normal and Cy or BMS treated rats.

Plant No. 098 : Fractions A, B, and C reduced the antibody synthesis while fraction D increased the response.

Plant No. 069 : Fractions RLJ-NE-475, 485, 486, 487, 488, RLJ, Sy (P.E. and ethyl acetate) 487A, B, C, D, E, 497A & B and 533 A & B were evaluated for immunomodulatory activity. All the fractions have shown varying degrees of immunostimulatory effect on the humoral immune response. Highly significant activity was obtained with fractions 487, 488, 533B and 593.

Livzone : Oral administration of formulation Livzone for 21 days prior to immunization and for 7 days after immunization enhanced immune response at lower dose level (50 mg/kg). A 1:1 mixture of *Terminalia belerica* and *T. chebula* produced a dose related increase in humoral immune response.

01 RC 04 Bioavailability Enhancer

(a) RLJ-NE-210

(i) Phase I clinical trial data on formulation AT-3 containing bioavailability enhancer RLJ-NE-210 has been compiled and submitted to DCI. Permission for Phase II clinical trials has been granted.

(ii) Preclinical dossier on the formulation AT-1 has been compiled and submitted to DCI. Permission for Phase I clinical trials has been granted.

(iii) Distribution studies with radioactive RLJ-NE-210 in rats have shown a significant localization of the compound in rat absorptive tissues (stomach, intestinal mucosa and epithelial cells) during early periods i.e. 5-60 min. post-dosing.

(iv) Continuous and intermittent (alternate day) dosing of animals with formulation AT-3 for 35 weeks has been completed. Levels of rifampicin were maintained in animals dosed with AT-3 upto the end of the study period. No significant difference in plasma drug levels existed between continuous and intermittent studies.

(v) Shelf-life and stability studies performed so far with the formulations AT-1 and AT-2 under natural conditions has revealed that RLJ-NE-210 offers 22-25% protection to the basic drugs in both the formulations.

(vi) Effect of RLJ-NE-210 on reabsorption of pyrazinamide was studied. A dose of pyrazinamide (400 mg/kg) was orally administered to rats either alone or in combination with RLJ-NE-210. Levels of pyrazinamide were determined in the plasma and urine samples of rats simultaneously at different time intervals (0.5-24 hrs). It was observed that by 5 hrs post administration the levels of pyrazinamide increased in the plasma of RLJ-NE-210 + pyrazinamide treated animals. This indicates increased reabsorption as one of the possible phenomenon responsible for raised levels of the drug.

(vii) Acetylated derivative of INH has been prepared and characterized. The procedure for simultaneous estimation of INH and its acetylated derivative has been standardized. Balance sheet of bound, free and acetylated derivative in urine of rats is being established.

(viii) Specificity of action was studied. Battery of cell lines expressing differentiated functions of the cytochrome P450 were used to study the modulatory effect of RLJ-NE-210 on the cytotoxicity and the genotoxicity mediated by the bioactivation of different forms of cytochrome P450, of certain chemicals and promutagens. RLJ-NE-210 strongly protected the cells in culture against the cytotoxicity of the benzo(a) pyrene (B (a) P), trans-7,8-dihydroxy-7,8-dihydrobenzo (a) pyrene (B (a) P-7,8-diol) and 1,3-dinitropyrene (1,3-DNP), chemicals known to be metabolised by Cyt P450 1A1 forms of enzymes. Genotoxicity induced by B(a) P-7,8-diol and aflatoxin B1 metabolised by phenobarbital inducible enzymes, was reduced in genetically engineered constructs of rat and human Cyt P450 1A1 and 2B1 respectively in presence of RLJ-NE-210. These studies indicate RLJ-NE-210 to be a strong inhibitor of 1A1 and 2B1 forms of Cyt P450 in cell cultures. Regulation by RLJ-NE-210 of the gene expression of Cytochrome P450 1A1 at transcription and translation level was observed. This indicates that RLJ-NE-210 does not effect the down regulation of 1A1 gene or destroy the enzyme but on the other hand, contributes to the inhibition of the activity by acting directly on the enzyme.

(b) Effect of RLJ-NE-210 on other biochemical functions

(i) *Inhibitor of NAD/NADH dependant dehydrogenases* : RLJ-NE-210 was found to impair strongly the activity of various dehydrogenases viz. malate dehydrogenase, glutamate dehydrogenase, UDP-glucosedehydrogenase of liver with K_i of 10-15 μm . It was found to quench completely the fluorescence of 1-ANS binding to glutamatedehydrogenase. Conjugated double bonds of RLJ-NE-210 molecule were related to inhibition.

(ii) *Influence of structural analogues of RLJ-NE-210 of monooxygenases activities* : Inhibition of monooxygenases activities *in vitro* was

earlier used as a prescreen for drug bioavailability enhancer. Studies conducted in cell cultures, in mice after oral administration and with hepatic microsomes, indicated that RLJ - SY. 195,196,199 and-507P3 are interesting molecules of potential importance.

(iii) *Effect on intestinal transport of drugs* : Transport of three drug molecules viz. salicylate, isoniazid and 1-naphthol across small intestine of rat was investigated *in situ* and *in vitro*. *In situ* transport was studied in rat small intestine after cannulation at the duodenal and ileocaecal ends. Six rats were used at a time and perfusion was aided by multichannel peristaltic pump from anterior to posterior end. After 30 min. of equilibration, samples were collected at 10 min. interval (single perfusion) for analysis. RLJ-NE-210 at 30 and 100 μm did not influence the absorption of salicylate. Absorption of isoniazid as such was very low (18%) while RLJ-NE-210 further lowered its rate by 33 to 66% at the indicated concentration. In everted sacs, this compound (30-100 μm) added on the mucosal side did not affect the transport of 1-naphthol. When stomach was ligated at the pyloric end and 45 min. after oral administration of RLJ-NE-210 (15 mg/kg b.wt.) everted sacs were prepared, the transport of 1-N was found to increase on the serosal side, proportionate to decrease in 1-N-glucuronide. These studies indicated that RLJ-NE-210 absorbed efficiently from the stomach distributes within the mucosal cells through blood supply where it might offer protection to certain drugs transport against intestinal biotransformation.

01 RC 05 Studies on the Behaviour of GIT Hormones under the Influence of Drugs Causing GIT Dysfunction

Studies were undertaken to evaluate the effect of RLJ-NE-014 and its fraction R 1, R 2, R 3, R 3 A and R 3 A1 on the gastric and intestinal damage caused by free-radicals. A model was used in which the effect of these extracts was assessed against indomethacin-induced changes in status of lipid peroxidation in the gastric and intestinal mucosa. A freshly prepared whole extract (RLJ-NE-014) and the fraction R 3 A were found to be effective in lowering the indomethacin-induced LPO levels.

01 RC 07(1) Development of New Pharmacological Screens

A new model employing latex of papaya as an inflammagen has been developed for testing anti-inflammatory activity. The latex (exudate) was harvested from the unripe papaya fruit and dried under vacuum. The latex was then suspended in 0.05 M sodium acetate buffer. This suspension when injected in rat hind paw produced concentration-dependant inflammation. Of the 0.25% of this suspension, 0.1 ml was found deal for evaluating anti-inflammatory activity of test drugs. This concentration produced

70%-100% inflammation lasting for about 5 hr with maximum effect at h 3. The test drugs employed were prednisolone, aspirin, indomethacin, phenylbutazone, ibuprofen, piroxicam, chloroquine, levamisole, and a mixture of boswellic acids. For comparison, these drugs were also tested against carrageenan-induced inflammation. All the test drugs-steroidal, aspirin and non-aspirin-like showed anti-inflammatory activity against latex-induced inflammation. The activity of chloroquine, levamisole and boswellic acids was significantly more against latex as compared with that of the carrageenan model. The inflammation caused by latex may be attributed to both its hydrolytic enzymes (papain and chymopapain) and glutathione, the activator of these enzymes. These enzymes seem to act like lysosomal enzymes that are released in inflammatory disease processes which mediate inflammation by stimulating the synthesis of prostaglandins. The papaya latex-induced inflammation model appears to be a sensitive, broad-based, and relevant one likely to prove useful for discovering new and effective drugs against inflammation and rheumatoid arthritis.

01 RC 07 (2) Use of Mammalian Cell Culture and Hepatocytes in Pharmacology

(a) Isolated hepatocytes

Hepatocytes were isolated after calcium-free perfusion of rat liver followed by collagenase recirculation. Hepatocytes with viability of more than 85% were used. Incubation of cells in different media was standardized and cells were found to maintain their viability for more than 4 h in Hank's Balanced Salt Solution (HBSS). Concentration and time-related hepatic damage in terms of alteration in biochemical functions was measured in response to three classical hepatotoxicants, *i.e.* carbon tetrachloride, paracetamol and D-galactosamine. Differential biochemical response *viz.* leakage of enzymes, lipid peroxides, GSH and UDP-glucuronic acid contents, towards each hepatotoxicant was established. All these studies were aimed at validating the model for rapid screening of hepatoprotectives.

Silymarin and its isomer silybin at 0.4 mM offered significant protection against CCl₄ or paracetamol mediated damage. Sensitivity of the model towards chemicals damage could be enhanced using hepatocytes from phenobarbital or 3-methylcholanthrene treated rats because of the inducibility of CYP450s responsible for activation of CCl₄ and paracetamol.

(b) Reuber rat hepatoma cell line, H4IIEC3/G

One major drawback associated with the use of hepatocytes is their loss of differentiated functions in primary culture. One would therefore, require alternative with stable expression of differentiated functions in supplanting hepatocytes. Various cell lines and their descendants derived from rat Reuber hepatoma are grown in this laboratory. These cells vary in their expression of differentiation, such as the presence of phenobarbital inducible cytochrome P450s. One such cell line H4IIEC3/G — grown in DMEM with antibiotics and foetal calf serum exhibited concentration and time related toxicity towards paracetamol. Validation of these cells as tools for rapid monitoring of antihepatotoxicants is currently being investigated.

02 NATURAL PRODUCTS (CULTIVATION)

02 RC 01 Screening and Development of Aromatic Plants for Important Essential Oils and Aroma Chemicals

(a) *Ocimum canum* Sims (Linalool strain)

(i) *Release of linalool rich variety of Ocimum canum* : A newly evolved linalool rich variety of *O. canum* (code name RRL-OC-11) was released by Dr.S.Varadrajan, Ex-DGSIR on RRL Jammu Foundation Day (1.12.1992) for commercial cultivation in the country, alongwith the brochure on "RRL-OC-11". Seeds of the new variety, its oil and pure linalool were presented by the Chief Guest to the new entrepreneurs present on the occasion. About 15 kg seed was made available to the farmers for commercial growing in Himachal Pradesh, Punjab and Uttar Pradesh.

The new variety grown on a commercial field was evaluated for its economic potential with the application of recommended agronomic inputs. It was observed that the crop gave three harvests during the year in the month of June, August and October at 70, 55 and 65 days intervals. Maximum oil content (0.5 to 0.7%) was obtained in June and October harvests with 70 to 72% linalool. The recovery of oil in rainy season was (0.2 to 0.3%) with 50 to 60% linalool. During 7 months growing season the crop gave about 230 kg oil and net profit of about Rs.18,000/- per hectare.

(ii) *Crop-weather interaction study* : The energy summation indices viz., degree days, pan evaporation and phenothermal index were found inter-related with essential oil content and linalool. 1.0% oil content and 72% linalool in oil was observed at 2943 degree days and 648 (mm) CPE at seed setting stage. Short term weather conditions as phenothermal in-

dex varied from 25.36 to 27.48 at different crop stages with marginal influence on oil content and its quality.

(b) *Ocimum canum* Sims (Methyl cinnamate strain)

(i) Breeding of *O. canum* for developing a methyl cinnamate rich strain was carried out. Selection studies of the segregating population of both selfed and controlled selectants followed by chromatographic evaluation has resulted in isolating promising genotypes having essential oil upto 0.6% (FWB) with 75-80% methyl cinnamate besides having higher herb yield. These selectants have been selfed for carrying out further improvement studies.

(ii) Physiological studies were initiated in this chemotype of *O. canum* for achieving; (a) increase in biomass and oil yield, and (b) for studying the dynamics of oil contents and its constituents during different growth phases. Growth regulators like gibberellic acid and Triacontanol at different concentrations have been tried.

(c) *Ocimum carnosum* LK. et Otto.

(i) *Polyploidy breeding* : *O. carnosum* has been bred through induction of colchiploidy to get a rich source of elemicin with increased yield potentials. Elemicin is highly valued as pharmaceutical agent besides its flavouring properties. The selection studies of the C₁ segregating generation carried out during the year 1992 has resulted in evolving elite genotypes with increased oil content (0.6 to 0.8% FWB) besides having higher herb yield. The elemicin content in oil ranged from 60-65%. Besides this, physico-chemical constants of essential oil have been worked out which were almost in accordance with B.P.

(ii) *Physiological studies* : After the first harvest of *O. carnosum* crop taken in July, 1992, a second course of foliar application of growth regulator "Nutron (Triacontanol)" was given. Of the different parameters studied (Table -2), crop growth rate (CGR), leaf area and leaf area index (LAI) had high values as compared to controls. Consequently, biomass and herb yield per plant also increased. Maximum effect was noted at 10 ppm conc. of TRIA. Specific leaf weight (SLW) and net assimilation rate (NAR) did not show any significant increase with this treatment.

(d) *Ocimum adscendens* Willd.

O. adscendens is being developed as a source of farnesol which forms the basic raw material for the synthesis of vitamin E, isolated as tocopherol (C₂₉H₅₀O₂). Screening and evaluation study of *O. adscendens* population raised earlier has shown the presence of farnesol upto 30% in

Table 2 : Growth Analysis of *Ocimum carnosum* with growth regulator 'Nutron' (Triacontanol) treatment

Parameter*	Triacontanol conc. µg/ml			
	0	10	15	20
Plant height (cms)	48.5	50.9	54.4	50.0
No. of laterals	5.7	5.5	5.6	6.3
Leaf area (cm ²)	10.6	11.6	10.3	11.4
Total biomass	143.0	166.3	156.6	147.5
yield gms (d.w.b.)				
Herbage (d.w.b) gms	85.2	106.3	97.7	91.3
LAI	2.2	2.7	2.2	2.7
SLW (g cm ⁻²)	0.011	0.011	0.011	-
CGR(g/day/plant)	0.84	1.10	0.79	0.77
NAR (g cm ² d ⁻¹)	0.35	0.51	0.33	0.33

* Mean of 10 units each of readings obtained in October, November and December.

oil with low essential oil content, although the flowering racemes at mid-flowering stage yielded higher essential oil content (upto 0.7%). Low genetic variability was encountered in the screened population. Efforts were made to induce greater variability for selection. Selections based on yield pattern in the screened population were made and the selected genotypes were allowed to breed freely. In the successive generation, the selected seed progeny after screening exhibited appreciable range of variability in essential oil content (from 0.16-1.30% on fresh basis) and farnesol (25-60%). Further selections from the screened population were based on low, medium and high yield characteristics. The same breeding procedure was adopted among the resulting selectants and the new seed-raised population will be subjected to next phase of screening and evaluation to locate elite genotypes showing improvement in both quantitative and qualitative yield parameters.

(e) *Clocimum 3C*

An improved hybrid strain of *Ocimum gratissimum* having high essential oil content (1.2-1.5% on fresh whole herb basis) with increased eugenol content (85-90%) has been developed. The yield performance trial of the new strain is being carried out at Field Research Station, Chatha. The high yielding strain has been subjected to comparative trials performance at selected places in North India, Kerala, Tamil Nadu and Maharashtra.

(f) *Ocimum americanum* (Citral rich strain)

This strain has been upgraded as rich source of citral. The crop is being grown in an area of 2000 m² to evaluate its economics. This is a short duration crop of 70-75 days giving 80 kg of oil per hectare from only one harvest. The yield of herb and oil was found to be 80% less in second cutting than the first cutting indicating that only one harvest is economical and should find place as short duration crop in regular field crop rotations. The oil content was 0.45% on pilot scale basis as compared to 0.5 to 0.65% in bench level distillation with about 79% citral in oil.

02 RC 02 Agrotechnology and Improvement of Economic Plants

02 RC 02 (02) *Apium graveolens* L.

Mutation Studies

(i) Following massive screening of segregating populations, a few partially made sterile plants, were isolated and carried forward for further studies. Genetic behaviour of two partially male sterile mutants viz., M44 and M45, induced by ethylmethane sulphonate and sodium azide respectively, was studied in M5 generation. Both these mutants exhibited typical monogenic 3:1 Mendelian segregation.

(ii) Nine mutants/selections of celery, selected earlier from various segregating progenies, were evaluated in comparison to check strain "RRL-85-1". Statistical analysis of data revealed that none of these selections could excel in seed yield and other economic characters over the check strain.

(iii) Effect of various physical and chemical mutagens viz., Γ -rays, sodium azide, ethylmethane sulphonate, ethidium bromide and streptomycin was studied on various biological parameters such as seed germination and shoot & root length. In general, all the three parameters decreased with the increase in the dose.

02 RC 02 (03) *Cymbopogon*

(a) Improvement of lemongrass

In the programme of continued upgradation of lemongrass (strain CKP-25), both conventional and induced mutation studies were taken up.

In conventional breeding methods, one of the F₂ selections of reciprocal cross of CKP-25 was selected, which besides being more hardy, has

less mortality value and high oil yield. This selection (CKP F₂ 38) is being multiplied vegetatively in 800 m². 1 and 2 harvests were obtained in the 1st year. The extrapolated yield works out to be 40 tonnes herb and 200 kg oil per hectare. The survival rate was found to be 75 to 80% even under water shortage condition during summer.

In induced mutation studies screening of M₁V₁ generation of CKP-25 revealed maximum variation in herb & oil yield and oil percentage in 20 KR of Γ -ray dose. Selection was carried out on the basis of oil yield and hardness of the plant.

(b) Aroma chemicals

Under the programme of screening of *Cymbopogon* for aroma chemicals, one selection of *Cymbopogon flexuosus* (GP-100) was confirmed to have α -bisabolol as major compound by ¹H NMR, ¹³C NMR and GCMS. Other compounds identified are geraniol, linalool, citronellol citronellal, geranyl acetate and some hydrocarbons. The crop is being multiplied vegetatively in an area of 400 m². Two harvests were taken in the first year and extrapolated yield works out to be 40-45 tonnes herb and 150-160 litre oil per hectare. Recovery of bisabolol and other sesquiterpene compounds were increased by monitoring the distillation time.

Another chemotype of *C. flexuosus* i.e. GP-150 was confirmed to be having 70-75% methyl isoeugenol in its oil as major compound. Methyl isoeugenol was confirmed by ¹H NMR and ¹³C NMR. Oil recovery was 0.2 to 0.4% on fresh weight basis.

(c) Diseases

A leaf blight disease of *Cymbopogon martini* var. *motia* was recorded at Chatha farm. The causal organism was identified as the *Curvularia lunata* (Wakkeer) Boed., Var. *aeria*. Different samples were collected, isolated and from them obtained four distinct types of isolates, (PR1, PR2, PR3 and PR4). These four isolates were tested for the variation in the production of cellulose components and toxic metabolites. They could not produce host specific toxin but the amount of toxic metabolites varied. They also varied in the production of cellulose components. They were further tested for their interaction on PDA plates and it was found that they developed a distinct demarcation line in all the four isolates at the crossing point to each other. These *in vitro* testings of four isolates indicate the presence of physiologic races of the pathogen which can be utilized for screening the resistant lines/varieties of *Cymbopogon* species.

(d) Agronomic studies

For the development of agro-technology of the new lemongrass variety CKP-25, some agronomic experiments were conducted during the year and the summary of the findings is given below:-

(i) *Effect of spacing* : The results of fourth year crop of CKP-25 under different spacings revealed that there was no significant increase in herbage and oil yield per hectare. However, maximum herbage (78.5 tonnes/ha) and oil yield (390 kg/ha) was obtained in five harvests under the spacing combination of 50cm x 50cm. The yield showed a 12.35% decrease in oil yield in 4th year as compared to 3rd year crop. Different spacings had no significant effect on oil and citral content of the crop.

(ii) *Effect of nitrogen* : The application of 340 mg N/ha in five harvests in the 5th year yielded maximum herbage (51.43 T/ha) and oil (350.94 kg/ha), being 73.4% and 48.2% per hectare higher respectively over control. However, the differences in herbage and oil yield were found non-significant among the 160, 220 & 280 kg/ha doses of nitrogen. Increased application of nitrogen (160 to 340 kg N/ha) did not show any beneficial effect on oil content of the plant whereas citral content decreased marginally in highest dose of nitrogen.

(iii) *Effect of NPK* : Twenty combinations of different doses of nitrogen, phosphorus and potassium were compared on a 2nd year crop of CKP-25. The combination of N₂₀₀ x P₁₂₀ x K₁₀₀ gave maximum herbage (82.5 T/ha) and oil yield (412.5 kg/ha) without affecting the oil and its citral content. The plant height and number of tillers per plant also increased significantly at this level of fertilizer combination than control.

(iv) *Effect of zinc* : Zinc deficiency was observed in this crop to affect the herbage and oil yield considerably. A marked increase in herbage yield was observed with the application of zinc doses over control. A significant effect in terms of oil content was found with 0.3% concentration of zinc on foliar spray as compared to control and other doses of zinc applied either through soil or foliar application.

(v) *Effect of triacontanol* : Lowest dose (10 ppm concentration) of triacontanol had a positive effect on herbage and oil yield per hectare over control in 5th year crop of CKP-25. An increase of 17.6%, 15.1%, 18.3%, 12.4% and 14.4% was found in terms of herbage yield over control in the first, second, third, fourth and fifth harvests respectively during the year. Higher concentration at 60 and 80 ppm showed a negative response in herbage yield. No effect was observed on oil or citral content of the crop due to any concentration of triacontanol in any of the five harvests obtained.

(vi) *Autoecological studies* : The crop phenology was studied in relation to essential oil content and biomass production at different leafing stages in a second year crop of CKP-25. Maximum essential oil content (0.96%, v/w, fresh weight basis) and essential oil growth index value (+ 0.15) were observed at 5th leaf stage corresponding to first week of May after taking the last harvest in the month of October and increase in phyto-mass was 75% upto June. The citral content was 82%.

02 RC 02 (04) Saffron

(a) Tissue Culture Studies

(i) *Shoot proliferation from callus cultures* : After establishment of the callus, controlled organogenesis was carried out by manipulation of growth factor and changes in nutrient media. Multiple shoot formation is the most crucial phase in development of micro propagation system for a plant. It is the efficiency of this phase which determines the ultimate yield of fully differentiated plantlets. Induced callus grew as yellowish, translucent calli upto 3rd passage after which there was shift in morphogenetic expression. Compact nodular calli on regular subculture showed shoot bud differentiation after 5 passages. The shoot buds failed to develop and multiply further, when maintained on the induction medium. The conditions for the regeneration of shoot *via* callus cultures were determined. Different combinations of media were checked for improvement and increase in the number of shoots. BA + NAA combination, low temperature incubation were found to be most responsive for proliferation of shoots.

(ii) *Corm formation in vitro* : A procedure of *in vitro* corm development at base of shoots, proliferated from callus, has been worked out. Studies aiming to determine factors which control saffron corm formation in excised shoots are currently being continued.

(iii) *Somatic embryogenesis* : In continuation of our studies on somatic embryogenesis, further studies to define parameters for optimal maintenance of repetitive embryogenesis and improved maturation of somatic embryos for high frequency conversion of somatic embryos to plantlets, was carried out. Suspension cultures were raised from callus culture with an aim to induce embryogenesis in suspension cultures.

(b) Plant breeding and agrotechnology

(i) *Effect of fertilizers* : Fertilisers response of flower yield in saffron in 4th year was at par with that of 2nd year but less than that of 3rd year. The over all fresh flower yield recorded a decrease with and without fertilizer application in 4th year. The trend of increased flower yield, however,

continued over past four years of application of P at 30, 70 kg/ha alone or in combination with different levels (20, 30, 40 kg/ha) of potash.

(ii) *Effect of size of corm* : Corms with 1.5-2.5 cm diameter (3-8.5 g weight) at planting recorded a high frequency of flowering in 4th year of experimentation while bigger corms (3-3.5 cm diameter; 10-16 g weight) had comparatively less flowering in the 4th year.

(c) Control of corms rotting

A severe pathogen, causing corms rotting of *Crocus sativus* belonging to a species of *Basidiomycotina* (M1-355486) was observed in different places of Kishtwar. Four isolates numbering K1, K3, K4 and K5 were screened on the basis of the variation in the colony characters. They were tested further for the variation in the production of biomass on the synthetic liquid medium and production of cellulose components on two cellulose inducers namely cellulose powder and microcrystalline cellulose. Isolate K1 produced the maximum biomass (1.55 g/100 ml of the liquid medium) and the minimum was produced by K3 (660 mg/ 100 ml). However, isolate K1 showed the least amount of activity in all the three components of cellulose (filter paper activity, CMCase and B-glucosidase). The remaining three isolates (K3, K4 and K5) produced better activities of cellulose components than the higher biomass producing isolate K1. The characteristic variability in the isolates of corms rotting pathogen showed the presence of physiologic races of the pathogen. With the help of these isolates, improved inbreds/varieties/genetic materials can be tested for the screening of resistant corms against that pathogen.

Six antagonistic fungi namely *Trichoderma viride*, *T. lignorum*, *T. koningii*, *T. pelluliferum*, *T. harzianum* and *Gliocladium virens* were tried against corms rotting pathogen. They control the growth of the pathogen from 20-80%. Seven selected fungicides namely Arasan, copper sulphate, Dithane M-45, Fytolan, Delsan, Dexon and Kitazin in a low concentration of 0.1% were able to check the radial growth of the pathogen upto 80%. When seven fungicides and six antagonistic fungi, were tried in combination, *T. lignorum* with Delsan and Fytolan and *T. koningii* with Dithane M-45 were found to check the pathogen above 80% under *in vitro* test conditions.

02 RC 02 (5) Hops

(a) Field trials

Experiments on the cultivation of hops in Bhaderwah, a new alternate area identified by RRL, have been successful. Based on the performance recorded in 1991, a commercial field trial of three varieties *i.e.* Late Clus-

Table 3 : Soft Resin Analysis of Two Hop Varieties

Variety	Location	Soft resins (%)	
		Alpha acids	Beta acids
Late Cluster	Bhaderwah	12.00	4.86
	Keylong (Lahaul)	9.16	7.26
	Kaza (Spiti)	7.16	9.00
Harmukh	Bhaderwah	12.40	4.43

ter, Harmukh and Talisman was laid out in one hectare plot. The plants were trained in the second week of May. The plants came in burr stage in late June and cones matured in early August. The varieties showed almost identical growth pattern excepting Harmukh in which development of laterals was more profuse. A yield of 1 to 1.5 kg fresh hops/plant was obtained in the two year old plants. The content of alpha acids was higher in Harmukh and Late Cluster as compared to Talisman.

Similar trials were also conducted in new areas of Distt. Lahaul & Spiti. The variety Late Cluster performed well in new pockets of Lahaul valley but in Spiti valley the cone size was small (2.0 cm) with alpha acid only 7.37% against 9.16% reported in Lahaul valley.

(b) Survey of new areas

An extensive survey of the hill districts, Chamba and Kinnaur, besides Lahaul & Spiti of Himachal Pradesh was conducted in August, 1992 in collaboration with HP Department of Horticulture. Experiments were laid out at Kellar (Pangi valley), Pooh (Kinnaur) and Udaipur (Lahaul valley).

03 NATURAL PRODUCTS (CHEMISTRY)

03 RC 01 Anti-inflammatory activity of *Boswellia serrata*

Artificial mixtures RLJ-NE-461, 461-A, 461-B, 461-C and 461-D were prepared for pharmacological evaluation. None showed better activity than the natural mixture. Three minor triterpenoid acids were isolated from the active mixture.

Pharmacokinetic studies were conducted for the active principles in experimental rats. It was observed that optimum levels of drug was attained within fifteen minutes of intake.

03 RC 03 Screening of Plants for Edible Pigments

(a) Xanthophyll from marigold flower petals

Marigold flowers are the best source of xanthophylls and leutein accounts for 60% of the total carotenes. Leutein & leutein fatty acid esters are common carotenoids in edible plants and as such xanthophylls are potential food colorants for human consumption. The high solubility of leutein/leutein esters in vegetable oil (25%) compared to poor oil solubility of FDA approved synthetic colorants is a very important factor for the commercial application of leutein as colorant in foods. A process for the isolation, extraction and estimation of xanthophylls from marigold flower petals has been developed. The details of conversion of xanthophyll esters to xanthophyll have also been worked out.

(b) Safflower yellow from *Carthamus tinctorius*

Safflower yellow a major constituent of *Carthamus tinctorius* flower petals finds use in colouring of the food preparations like cakes and biscuits. When the pigment is used in large quantities it acts as a cathartic. A method has been developed to isolate safflower yellow from the water extract of *Carthamus tinctorius* petals.

04 BIOTECHNOLOGY

04 RC 01 Production of Microbial Oils and Fats

(a) Optimisation studies

The optimisation for the production of gamma linolenic acid (GLA) in bioreactors was continued with the organism MR-2. The optimisation of media was carried out and M-8 was found to produce the maximum amount of GLA as compared to other media. Table 4 shows the results of the bioreactor studies and it is shown that maximum amount of GLA is produced with aeration rate of 1.25 VVM, RPM 500 and continuous maintenance of pH at 4.0 during the period of fermentation.

(b) Isolation of mutant strains

The spores of MR-2 were exposed to gamma rays to get mutants of the parent strain. 2 K rads per minute exposure was given for 1, 5, 10, 20 and 30 minutes to 5 sets of spore suspension. It was observed that after 20 minutes of exposure 80-88% lethality could be obtained whereas 30 minutes are sufficient to cause 100% lethality. About 50 colonies were picked up after plating and incubation and further used for testing.

**Table 4: Production of Microbial Oils by Organism MR-2
(Glucose supplied 100 g/l)**

Medium	aeration VVM	RPM	Period of fermentation (Hrs)	Biomass (g/l)	Lipid (g/l)	GLA (%)	Total GLA (g/l)
M-8	0.75	400	168	18.0	2.5	5.56	0.139
M-8	1.00	400	168	19.0	2.75	6.00	0.165
M-8	1.25	400	168	19.0	2.90	5.90	0.171
M-8	1.50	400	168	20.0	2.90	6.10	0.177
M-8	0.75	500	168	18.0	2.60	4.50	0.117
M-8	1.00	500	168	21.0	3.00	5.4	0.162
M-8	1.25	500	168	23.8	3.6	8.5	0.306
M-8	1.50	500	168	23.0	3.5	8.0	0.28
*M-8	1.25	500	120	31.0	9.6	9.31	0.89
* M-8	1.25	500	120	32.5	10.0	10.1	1.01

* pH 4.0 maintained throughout the experiment.

Gamma irradiated mutant colonies of MR-2 showed biomass, lipid and GLA production (23-35.5g/l),(5.26 to 11.48 g/l) & (0.90 to 1.2 g/l) in shake flasks respectively.

(c) Studies with other organisms

Experiments were conducted in shake flasks with two strains of *Mucor javanicus* I & III and *M. vinacea* for biomass and lipid production in medium 2 and medium 8. *M. javanicus* I produced maximum biomass of 12.26 g/l and lipid 3.73 g/l at 144 hrs of cultivation in medium 2. *M. javanicus* III produced highest biomass of 10.6 g/l and lipid 2.64 g/l in medium 8. GLA was of the order of 0.25 g/l. *M. vinacea* produced maximum biomass and lipid of 11.2 and 4.3 g/l respectively in medium 2 at 168 hrs of fermentation, GLA produced was 0.18 g/l.

04 RC 02 Construction of Genetically Altered Organism for L-Ascorbic acid Production

(a) Studies on dehydrogenase gene of *Gluconobacter oxydans*

Cosmid gene bank of genomic DNA of *Gluconobacter oxydans* ATCC9937 was constructed and 4,000 clones preserved. Oligonucleotide primers were synthesised from the conserved regions of known sorbitol dehydrogenase gene sequences and amplified by polymerase chain re-

action (PCR). A DIG-labelled probe developed from the amplified DNA was colony hybridised and the 5.6kb DNA fragment identified carrying the particular dehydrogenase gene sequence.

The genomes of four keto-acid producing *G. oxydans* strains (ATCC9937, IFO3293, IFO12258 and DSM2343) were analysed by Pulsed-Field Gel Electrophoresis (PFGE). Seventeen restriction enzymes were tested for PFGE analysis of above strains. The genomic DNA digested with XbaI was analysed for fragment analysis. Good resolution of restriction fragments at all size ranges was achieved by using three different pulse time programmes. The genome size of the four strains was estimated as between 2240kb to 3787kb.

PFGE analysis of the undigested DNA allowed the detection of plasmids in the following strains: ATCC 9937 (3 plasmids, 8, 27, 31kb), IFO3293 (1 plasmid, 9kb) and DSM2343 (1 plasmid, 21 kb). The three plasmids in *Gluconobacter oxydans* ATCC9937 showed no homology to each other or to the plasmids in the other strains. Physical maps were completed for two of the three plasmids of ATCC9937 strain. When hy-

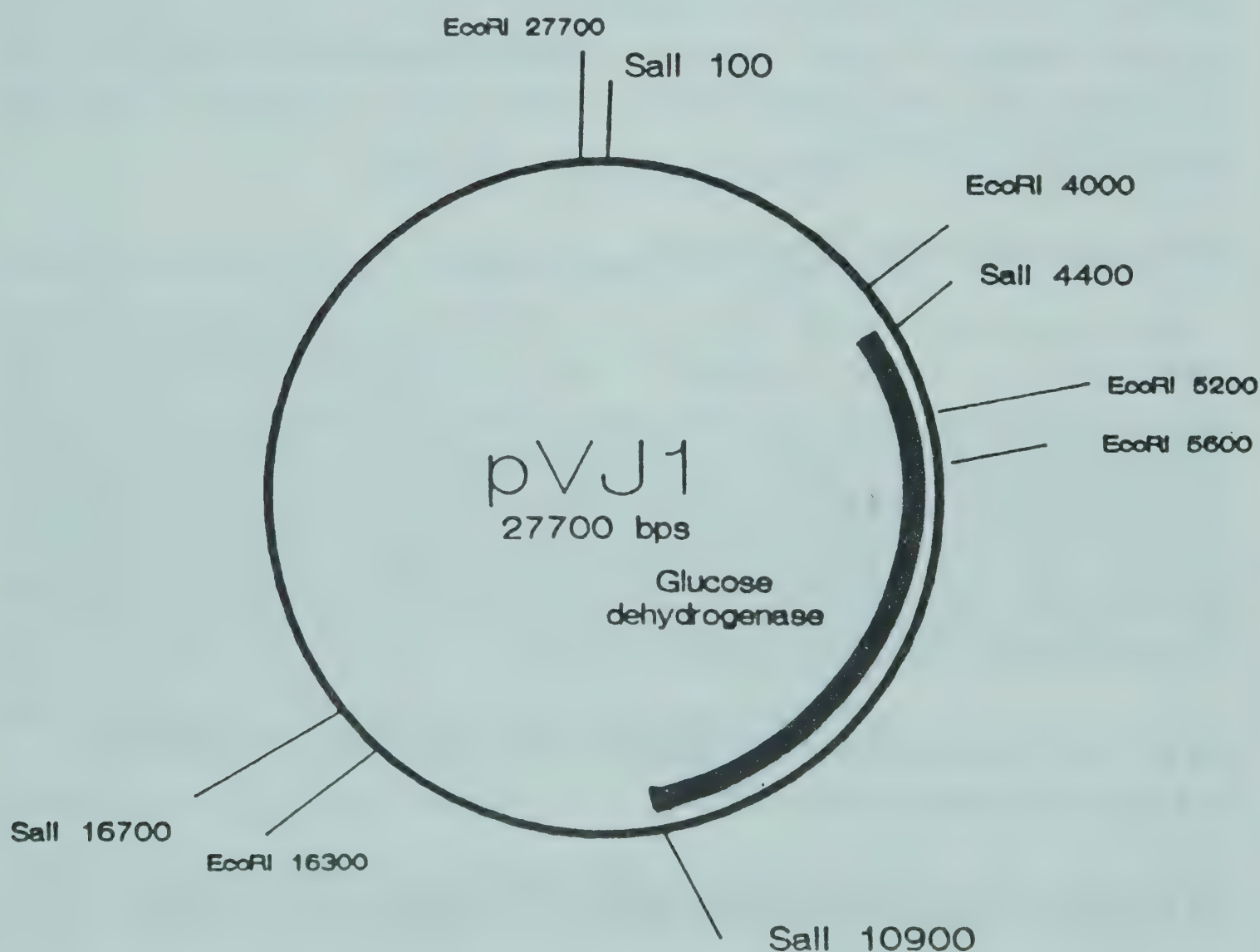


Fig. 1

bridized with the amplified DNA probe, the 27 kbp plasmid was found to carry a 6.5kb Sal 1 fragment having the same DNA sequence as that of the 5.6kb fragment of the cosmid library (Fig. 1). The dehydrogenase gene fragment has been successfully subcloned in PUC18 and the clones confirmed by cross hybridization.

(b) Studies on sorbitol dehydrogenase gene of *Erwinia herbicola*

Isolation of total and plasmid DNAs from sorbitol utilizing strain of *Erwinia herbicola* were standardised and the above DNAs isolated and purified on preparative scale.

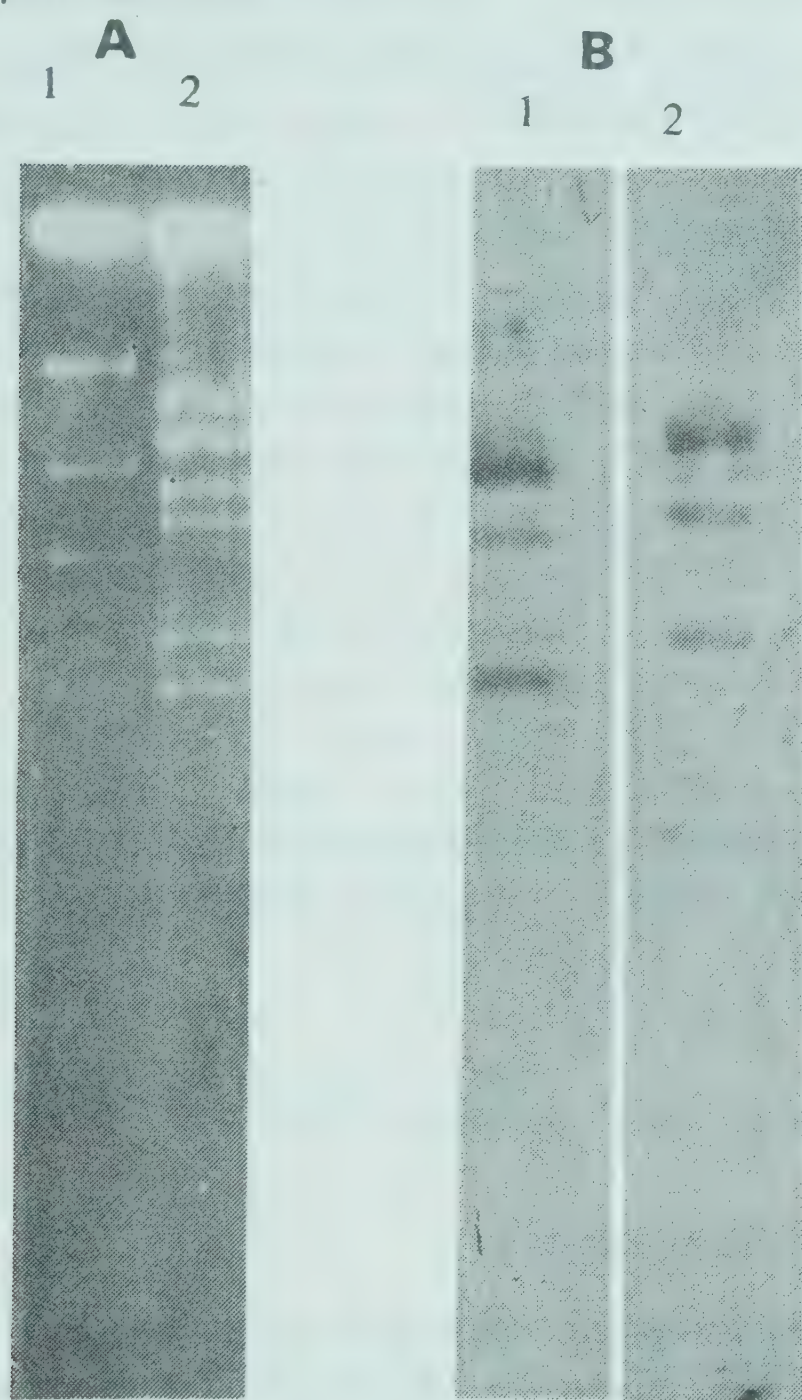


Fig. 2. Southern blot of the plasmid DNA preparation of *Erwinia herbicola* using DIG-labelled DNA probes developed from the individual plasmid DNA bands.

- (A) Lane 1, Lambda DNA HindIII marker
Lane 2, Plasmid DNA of *Erwinia herbicola*
- (B) Lane 1. Bands hybridising to probe 1.
Lane 2, Bands hybridising to probe 2.

Two dimensional electrophoresis of the purified plasmid DNA revealed the presence of two plasmids in the organism for the confirmation of which individual plasmid DNA bands were subjected to hybridization using non-radiolabelled DIG DNA probes (Fig. 2).

(c) Fermentation studies on 2-ketogluconate for the production of iso-ascorbic acids

Iso-ascorbic acid is an excellent antioxidant and acidulant widely recommended for use as a food additive to replace ascorbic acid. The open chain form of the iso-ascorbate is 2- ketogluconic acids. The latter sugar acid can selectively be produced by efficient dehydrogenation of glucose under controlled submerged conditions.

A suitable organism capable of direct dehydrogenation of glucose to 2-ketogluconate as a penultimate intermediate for iso-ascorbate synthesis was selected and primarily screened at shake flask level. Fermentation parameters for the optimum conversion of glucose to 2-ketogluconate were standardised at 10 l laboratory fermenter scale and further scaled up in 50 l stirred reactors. 95-98% of 750 mmol. l^{-1} h^{-1} glucose was selectively converted to 2-ketogluconate at a production rate of about 15 mmol. l^{-1} h^{-1} . Down stream processing of the fermentation broth for the isolation of the product was standardised at 5 kg batch.

05 POST-HARVEST TECHNOLOGY OF REGIONAL AGRO-HORTICULTURAL PRODUCE

05 RC 02 Development of Processed Diabetic Foods

(a) Diabetic apricot RTS beverage

The conventional RTS beverage contains 15-20% pulp, 13-18% soluble solids and 0.25-0.35% acids and are preserved by pasteurization. Added sugar plays a vital role in providing requisite body and flavour to the beverage. Efforts were made to develop a similar product without incorporation of sugar. Sorbitol, fructose and aspartame were attempted singly or in combination as substitutes for sucrose. 6.5% sorbitol + 5.5% fructose, 6.5% sorbitol + 35 mg % aspartame provided desirable flavour. However, the product lacked requisite body. Use of 0.25% carrageenan or 0.3% sodium alginate or 0.25% CMC improved the consistency but contributed towards unacceptable after taste.

Three different types of low methoxyl pectins viz. LMP 101 AS (36% degree of esterification and 14% degree of amidation), LMP 102 AS (32% degree of esterification and 18% degree of amidation) and LMP 104 AS (28% degree of esterification and 20% degree of amidation) were attempted. Use of 0.2% LMP alongwith 40 mg % Ca ions yielded optimum viscosity and mouthfeel. The beverage had 7.8% total soluble solids, 1.3% natural sugars, 0.08% protein, 0.02% fat, 0.01% fibre, 3.5 mg % ascorbic acid and 132 KJ energy/100 g beverage.

(b) Diabetic canned apricots

Studies were conducted on canning of apricots for diabetics using Poonch variety and sorbitol syrup as covering liquid. In one set of experiments, sound fruits of uniform ripeness were processed following the standard procedure of canning in one lb plain tall cans and sorbitol as covering liquid in concentration ranging from 35-50%. In second set, the skin from the fruit was removed by a conventional lye treatment for 40-60 seconds followed by rinsing in plain water and canning like 1st set of experiments. A control lot with 40° Brix sugar syrup was also made. Cut out data obtained after 15 days of storage at ambient temperature showed that skin does not remain intact during processing in case of unpeeled fruits. The skin separated from the fruit halves resulted in unpleasant appearance as compared to lye treated canned fruits. Cut out analytical data showed that sorbitol concentration in covering liquid (35-50%) did not effect the drained weight, texture, colour and flavour of the canned product. However, it had marked impact on the taste attribute. 40% concentration of sorbitol in covering liquid was found optimum to produce most acceptable taste as compared to higher and lower concentrations. The texture of all lots was found to be mushy and soft thus necessitating the need for more work on texture improvement.

(c) Diabetic apple preserve

Studies were conducted to standardize techniques for preparation of apple preserve without the use of added sugar while retaining the natural appearance of conventional product. For this purpose, three apple cultivars viz. Maharaji, Red Delicious and Ambri were selected. The traditional techniques of pricking, texture improvement, and syruling were followed. Sorbitol was used as the covering syrup as a substitute for sucrose. The product was evaluated with respect to organoleptic attributes. The data showed that preserve made from Ambri variety scored highest (29.5) followed by Red Delicious (27.3). The Maharaji variety scored minimum points (23.3 out of 40) thus rated as least acceptable.

Before syruing, the fruits were treated with calcium by steeping in supernatant liquid of 2% Ca(OH)_2 for 12 hrs. To improve the colour attributes, the blanching was done in the boiling water for 6 min containing 500 ppm SO_2 and 0.2% citric acid. The product evaluation data showed that treatment of apple with Ca(OH)_2 had significant effect on texture improvement and scored 6.6 marks as compared to 4.9 by control. Similarly, SO_2 treated lot scored 7.8 marks for colour as compared to 4.7 in control.

For syruing purpose, xylitol, sorbitol and fructose were attempted singly or in combination and the brix of the preserve samples was raised to a final concentration of 70% TTS. For comparison one lot was also run with sucrose simultaneously. Preserve samples prepared with fructose singly or in combination (50:50) with sorbitol/xylitol were found comparable to the sample prepared with sucrose (control lot). These product samples possessed clean sweet taste and were found acceptable with respect to colour and flavour. The preserve was analysed and found to contain 0.26% protein, 0.04% crude fat, 0.27% mineral matter, 70% total soluble solids and 1187.9 KJ energy/100 g of preserve.

(d) Diabetic seasoned mango conserve

Spiced sweetened chutney with 68% sugars is a popular fruit product. Studies were conducted to develop similar mango shred conserve with low sugar content and high sensory attributes. Lots were prepared using raw mango shreds and ripe mango pulp in different concentrations in order to study the effect on product quality. The fruit pulp was softened by heating and then mixed with calculated quantity of sorbitol. Common spices were added when the solid concentration attained specific level (65° brix). In case of unripe fruits, the shreds were cured in 15% brine for 7 days and used.

For optimization of fruit content in the product, fruit pulp and hexitol were tried in different ratios (50:50, 45:55, 40:60 & 35:65). The product evaluation data showed that fruit pulp and hexitol in the ratio of 45:55 gave optimum results with respect to product appearance and acceptability. The final product contained 54.5% fruit. It was found that increasing concentration of soluble solids in the product scored progressively increasing marks with maximum marks for the highest concentration of 70% TSS attempted. Lot with 55° brix scored 4.8 whereas product with 70° brix scored 7.3 marks. Similarly lots prepared from unripe pulp were found to score more than the product made from ripe fruit pulp. The texture of the unripe fruit has possibly attributed towards the preference of the product. The lot having 70% TSS from unripe fruit scored 7.3 whereas same concentration of TSS from ripe mango scored 6.3 marks. The ex-

periment showed that cured shreds from unripe Sufeda mango may be used with advantage for the manufacture of seasoned mango conserve.

05 RC 04 Post-harvest Technology of Wild Pomegranate (*Punica granatum* L.).

(a) Storage studies of 'anardana' dried under different conditions

There was significant increase in moisture content after 6 months storage at ambient temperature in all the samples. The increase in moisture content in vacuum dried and roller dried samples was 36.4% and 37.4% respectively. This shows that there is need to standardize the packaging conditions for the storage of anardana. There was no significant variation in acidity. The crude fat, crude fibre and total ash contents remained unchanged. Significant loss of N₂ (36%) was observed in roller dried flakes, whereas, no significant variation was observed in reducing and non-reducing sugars.

(b) Rehydration ratio of 'anardana' seeds in relation to drying

Rehydration characteristics of anardana seeds were determined by steeping 10 g seeds in water (40° C) and weighing periodically till constant weight was obtained. The rehydration ratio varied from 1.2:1 to 1.6:1. The seeds dried at higher temperature showed significant higher reconstititional property due to high shrinkage.

(c) Development of equipment for separating arils from skin

The equipment designed and fabricated comprises a feed hopper for continuous feeding of pomegranate halves and 400 mm dia stationary stainless steel basket fitted with four baffles. Four impact elements of 100mm x 100mm size mounted at 45° to the shaft axis and run at 600 r.p.m. with 1/4 H.P. motor.

The fruit is cut into two halves and fed through the hopper. The fruit strikes the impact elements and are thrown tangentially to strike the baffles provided into the stationary basket. After striking the baffles the fruit changes its direction and again comes in the path of impact elements. The process of striking and hitting is repeated continuously till the seeds are extracted from the fruit skin. The skin becomes light in weight and comes out through the outlet provided at the bottom. The equipment has the capacity to process 30 kg wild variety and 60 kg table variety of pomegranate per hour.

The equipment was formally released on the occasion of CSIR Foundation Day (26 September, 1992) by the Commissioner-cum-Secretary, Department of Science and Technology, J&K Govt. and demonstrated to the 'anardana' processors and concerned State Government officials. The J&K Department of Science and Technology has placed orders with the Laboratory for the supply of two machines for demonstration and popularisation in 'anardana' processing areas.

(d) *Instant 'anardana' chutney*

A ready mix for 'anardana chutney' based on 66% roller dried powder, 10% sugar, 20% dried mint, 2% red chillies and 2% salt has been standardized. The 'anardana' powder along with all the ingredients are ground to 44 mesh size. The ready mix can be processed within 10 minutes into paste (2 parts water: 1 part dried mix) with desired taste, flavour and consistency.

06 MUSHROOMS

06 RC 01 Cultivation of Edible Mushrooms

(a) *Agaricus bitorquis* (Quel) Aacc.

Agaricus bitorquis, a temperature tolerant button mushroom was cultivated for the first time in a rural mushroom farm at Jammu and following experiments were conducted. For this purpose compost was prepared by long method of composting with wheat straw and chicken manure as basic substrate.

(i) *Effect of spawning intervals* : Spawning of the compost was carried out in the first and second week of September at 10 days interval. The trays which were spawned in the first week of September started production from 18th October and continued till middle of November. On an average 10 kg of mushrooms were harvested from one quintal of compost during 3-4 weeks of production period as against 13-14 kg of mushrooms for a production period of 6 weeks.

(ii) *Effect of supplementation* : Linseed meal was used for supplementation after complete spawn run at the time of casing. Early fruiting took place in supplemented trays, but no significant yield difference was observed with the control.

(iii) *Diseases* : During the course of cultivation following diseases were observed :

White plaster mould caused by *Scopulariopsis fimula*
Brown plaster mould caused by *Papulaspora byssina*
Green mould caused by *Penicillium* sp.
Bacterial blotch

Control of white plaster and brown plaster mould was achieved by alternate spraying with Dithane X-78 and Bavistin. However, no appreciable control was achieved with green mould and bacterial blotch.

(b) *Agaricus bisporus*

At present, growers in Jammu region are taking only one crop of white button mushroom (*Agaricus bisporus*) during winter months which lasts from November to April. Experiments were conducted to obtain two crops in order to have better productivity and financial return. For the second crop compost was prepared in December, 1992 with paddy straw which is available in plenty at cheap rate during winter months. It was spawned in the 1st week of January, 1993. The production started in March. 9 kg of mushrooms per quintal of compost were harvested during the production period of 4 weeks as against 13 kg of mushrooms for a production period of 22 weeks with one crop only.

(c) *Flammulina velutipes*

Winter mushroom *Flammulina velutipes* gets infected with number of moulds during its cultivation resulting in great loss to the crop. Studies were undertaken on 19 fungal moulds isolated from *F. velutipes* beds. The results indicated that all the moulds have faster growth than *F. velutipes*.

In no case was inhibition zone formed. Culture filtrate of different fungal moulds reduced the growth of mushroom mycelium.

(d) *Morchella*

The basal medium (soil extract agar) was supplemented with N, P, K either separately or in combination. Three concentrations of each of nitrogen, phosphorus and potassium (0.04%, 0.08% and 0.16%) were chosen. For nitrogen, ammonium sulphate, for phosphorus, calcium phosphate and for potassium, potassium chloride were used. An increased level of phosphorus was observed to play an important role in the sclerotial formation.

(e) Chemical screening

1 kg of dried mushrooms of two distinct species of *Russula* spp. was supplied for chemical screening.

07 UTILIZATION OF MINERAL RESOURCES

07 RC 01 Utilization of Gypsum

(a) Coir gypsum (Coir-Gyp) Boards (Work sponsored by "Coir Board of India")

The semi automatic plant for manufacturing Coir-Gyp Boards was got fabricated as per the design conceived earlier. The plaster slurry mixer has been erected, while casting table and board formation-cum conveyer system are ready for erection.

(b) Coir-gyp boards as wood substitute (CSIR Thrust Area Project)

The Government of India has decided to ban wood completely in CPWD constructions with effect from 1st April, 1993. Our Laboratory has proposed Coir-gyp boards as wood substitute in certain uses. Two partition walls with doors etc., were constructed with Coir-gyp boards eliminating wood in an air conditioned room of CPWD office (Indraprastha Bhavan, New Delhi) for testing and performance evaluation studies by CPWD Chief Engineer (Technology and Development Cell) who was also supplied with a copy of "Specification for Coir-gyp door shutters with frames" prepared by our Laboratory. Our Laboratory participated in the exhibition of "New Materials in Building Industry", organized by CPWD and NRDC at New Delhi and exhibited the coir-gyp door, boards, panels etc. and their assembling techniques for partition and ceiling.

The surface finish of the coir-gyp panels was improved and sunmica lamination was given for use as door panels and furniture.

07 RC 02 Boron Based Chemicals

In continuation of the work on Barium metaborate, crystalline forms of tetra and pentahydrate were synthesized by a process developed in the laboratory. These forms were studied microscopically as well as by X-ray diffraction method. Abrupt precipitation at room temperature produces amorphous forms. Crystalline forms were, however, obtained by slow crystallization technique at lower temperature. The yield obtained in these forms was invariably >45%.

Thermal study was carried out to get their tri, di, monohydrate and anhydrous forms. It was observed that dihydrate and anhydrous forms were obtained readily while monohydrate form was obtained under vigorous conditions. Trihydrate form could not be isolated at all.

All these forms of Barium metaborate were studied by Insect Physiology section of this Laboratory for their insecticidal properties. The results

showed that dihydrate form was the most potent insecticide amongst all the hydrate forms of Barium metaborate.

Regeneration of decomposed trimethyl-borate was undertaken which was stored two years back. About 20% boron content loss was estimated in the decomposed product. Use of different additives produced the pure form.

07 RC 03 Thermal Decomposition of Gypsum

The study of the decomposition of gypsum to get cement clinker and sulphur or sulphuric acid or other salts of value has been taken up. The non-isothermal methods of thermal analysis (dynamic) have been used for the study of the decomposition reaction. In static air it has been found that two high temperature phases are formed before gypsum decomposes to CaO and SO_2 . This phenomena has been observed for the first time and confirmed by repeated experimentation. By using a variety of samples, it has been observed that the decomposition temperature is a function of the number of water molecules attached to CaSO_4 and the percentage of impurities attached to the sample.

09 SERICULTURE

09 RC 01 Chemical Compounds for Increasing Silk Productivity

(a) BPE-emulsion stability

As BPE is an alcohol or acetone soluble JH analogue, it becomes difficult to use it in the field. Thus efforts were made to formulate emulsifiable water concentrate of BPE so that it could be utilized in the field easily by the farmers. For making emulsifiable concentrate, 1 ml of BPE was dissolved in 10 ml of organic solvent (acetone/alcohol) and an emulsifier Tween-20 (0.1 gm) was added. The mixture was shaken until completely dissolved and a solution was prepared in water by adding 10 ml of water and shaken well for 1-5 minutes to obtain homogeneous solution. Three materials *i.e.* BPE acetone solution, BPE epoxide emulsion (water solution) and labomin (water solution) alongwith control (only water) were applied on worms in the fifth instar at 72 hr after last moult with a dose of $0.01 \mu\text{g}/10 \mu\text{l}$ per larva. It was observed that BPE-emulsion prepared in April is effective upto last week of July 1992. Similar trend is found in UV absorption also. It was 4.2 at 265 nm in April 1992 which came down to 2.8 at 265 nm in March 1993. Thus BPE in emulsion form is stable for a

period of five months only, after which the effectiveness of the compound is reduced and comes down approximately 50% within one year.

It has also been observed that with a dose of 0.01 µg/larva out of all the three compounds applied, BPE (pure) acetone solution is more effective than BPE emulsifiable water solution. Labomin at this concentration is less effective.

(b) Effect of phytoecdysone

Studies on plant No. 015 were further carried on. Crude alcoholic extract of the plant No.015 was prepared and crude ecdysteroid was extracted from this by the method of G.A. Kerkut and L.I. Gilbert (1985). Both the extracts alongwith its control (water solution) were applied in single dose application at 48 hr after 4th moult with the dose of 10 µl/20 µl of water. It was found that there is a very minor increase in silk production in the crude ecdysone fraction as compared to total alcohol extract.

09 RC 02 Development of Artificial Diet for Silkworm (*Bombyx mori* L.)

(a) Testing of diets under aseptic conditions

Two semi-synthetic diets (B&E) prepared by our Laboratory, Japanese commercial diet and leaf (control) were evaluated by rearing newly hatched larvae of four pure races (NB₇, NB₁₈, KA & NB₄D₂) and two hybrids (NB₄D₂ × KA & KA × NB₄D₂), 50 larvae of each race were brushed on the diets and leaf control were reared at 26 ± 1°C & 80% RH for 10 days under aseptic conditions. Fresh slices of diets were provided on 5th & 8th day after brushing and observations were recorded on 10th day. Most of the larvae brushed on Diet E died due to high moisture of the diet.

Results summarized in table 5 indicate that hybrids NB₄D₂ × KA and KA × KA NB₄ D₂ have better acceptability for artificial diets than the pure races, as is evident from the % survival and the total wt. of the surviving larvae. All the larvae reared on mulberry leaf and Japanese commercial diet attained higher larval weight than the larvae reared on Diet B. Larvae reared on Diet B grew unequally and could not moult second time in 10 days duration of rearing, indicating lack of sterols in the diet/poor growth rate. It was felt that diet needs further modification in terms of (i) improvement of physical and nutritional properties (ii) inclusion of feeding attractants and (iii) improvement in methods of diet preparation & cooking.

Table 5 : Evaluation of Artificial Diets on Silkworm

Race	Survival(%)			Total wt.of surviving larvae (g)		
	Leaf	Diet B	Jap. Diet	Leaf	Diet B	Jap. Diet
NB ₇	100	80	200	1.40	0.45	2.45
NB ₈	100	90	76	1.29	0.59	1.71
KA	100	72	74	1.48	0.25	1.23
NB ₄ D ₂	100	84	100	1.49	0.31	2.56
NB ₄ D ₂ XKA	100	100	96	1.81	0.93	3.94
KAXNB ₄ D ₂	100	100	100	1.74	0.74	2.63

(b) Testing of diet under normal conditions

Six semi-synthetic diets were prepared and evaluated by rearing newly hatched silkworm larvae of 4 hybrids and a pure race, under aseptic conditions in rearing room. A Japanese commercial diet and leaf control were also maintained for comparison in all six races.

The results summarized in table 6 indicate that, Japanese diet was best of all the diets tested, exhibiting highest survival % and larval weight. Hybrids showed better performance than the pure race NB₄D₂. Amongst other diets tested, diet I & IV appeared to be at par and second best, as indicated by % survival, whereas diet VI stood 2nd best on the basis of average larval weight.

Out of 5 silkworm races tested on artificial diets, PM × NB₄ D₂ was found to be the best exhibiting 52% survival %, whereas NB₄ D₂ × KA stood first on the basis of average larval wt.

Taking into consideration, both the parameters, (% survival & Av. larval wt.), hybrid NB₄D₂ × KA was best reared on diet VI whereas hybrid PM × NB₄D₂ was suitable for rearing on diet I & diet VI and hybrid A × B on diet VI.

(c) Another trial conducted to evaluate the rearing performance of four pure races namely NB₇, NB₁₈, KA & NB₄D₂ on six semi-synthetic diets and a Japanese commercial diet revealed that out of 4 pure races tested, NB₁₈ appeared to be the best followed by NB₇ on the basis of average larval survival %, whereas NB₇ exhibited highest average larval wt. (47 mg) followed by NB₁₈ (36 mg). Amongst all the diets tested, Japanese diet was the best (58%) closely followed by diet IV (56%) on the basis of average survival %. Larvae reared on diet IV at-

tained highest weight (58 mg) followed by Japanese diet (49 mg) and diet I & III (38 mg) (Table 7).

Table 6 : Testing of Semi-synthetic Diets under Sceptic Conditions

	(a) % Survival (10 days after brushing)							Mean
	Diet	Diet	Diet	Diet	Diet	Diet	JAP	
	I	II	III	IV	V	VI		
NB ₄ D ₂	35	28	18	32	30	30	42	31
A × B	52	42	40	52	40	55	55	48
NB ₄ D ₂ × KA	45	8	2	35	38	35	52	38
KA × NB ₄ D ₂	52	22	38	45	48	38	55	43
PM × NB ₄ D ₂	72	45	8	85	35	22	95	52
Mean	51	29	31	50	38	36	60	
	(b) Av.Larval wt (mg) (12 days after brushing)							Mean
	I	II	III	IV	V	VI	JAP	
NB ₄ D ₂	21	7	17	10	9	37	75	25
A × B	19	13	22	12	11	59	78	31
NB ₄ D ₂ × KA	32	20	40	29	18	105	110	51
KA × NB ₄ D ₂	36	11	15	16	12	46	99	34
PM × NB ₄ D ₂	72	24	30	14	16	71	79	44
Mean	36	25	25	16	13	64	88	

Table 7 : Rearing Performance of Silk Pure Races on Semi-synthetic Diets

Race	I	II	III	IV	V	VI	JAP	Mean
(a) Survival % of larvae								
NB ₇	40	25	15	70	48	-	70	45
NB ₁₈	60	10	80	50	60	-	70	55
KA	17	6	23	31	8	11	40	19
NB ₄ D ₂	27	7	13	73	7	13	53	28
Mean	34	12	40	56	31	12	58	
(b) Average larval weight								
NB ₇	62	67	35	111	26	-	30	47
NB ₁₈	52	30	52	34	15	-	36	36
KA	17	20	32	51	13	22	78	33
NB ₄ D ₂	20	10	35	34	20	10	50	26
Mean	38	19	38	58	18	16	49	

Considering both, the survival % and larval weight, best performance was exhibited by Race NB7 when reared on diet IV exhibiting 70% survival (at par with Japanese diet) and 111 mg larval weight (better than Japanese diet). Larvae reared were equal in size and reached 3rd instar in 20 days rearing, thus showing that diet IV is better than both controls *i.e.* Japanese diet and leaf.

10 INSECT PHYSIOLOGY

10 RC 01 Physiology of Insect Reproduction

(a) *Musca domestica* adult

(i) *Light and electron microscopy* : Histological and ultrastructural studies of adult *M. domestica* testis conducted in detail revealed the testicular follicle to be unpartitioned with radially-inclined germ cells *i.e.* the spermatogonia at the periphery followed internally by later developing stages and metamorphosing spermatozoa lying at the centre of the follicle. The testis continues into the calyx at its base.

Ultrastructurally the acrosomal part of the sperm was observed to arise from Golgi complex by a fusion of its vesicles. The centriolar adjunct and endoplasmic reticulum too emanated from the Golgi. The microtubular constitution of the flagellum was 9+9 (doublet) + 2.

In *M. domestica*, testes were also found to contain certain sperm-eiophagic cells, meant for phagocytosing the defective spermatozoa. These cells were formed by a complete transformation of some spermatocysts into giant structures that engulf the sperm *via* a series of vacuoles along their plasma membrane.

(ii) *Effect of plumbagin* : Plumbagin caused sterility in *M. domestica*, therefore its effect was pursued elaborately, light and electron microscopically on the testis. Within 72 hrs of treatment, plumbagin induced a number of deformities in the testis *e.g.* disappearance of many spermatocysts which made testis lose much of its compactness; delayed spermeiogenesis and melanization of the sperm bundles. The stored sperm of the calyx became loose and the secretion in the lumen of the calyx lost its viscous character.

In the developing spermatozoa an extensive vacuolation and disintegration of the organelles took place, especially of the microtubular element leading to a rapid destruction of the whole cell.

(b) Histology of pheromone-secreting glands of *Dysdercus koenigii*

After locating the pheromone/secreting glands of *D. koenigii*, some abdominal and thoracic glands were sectioned for light microscopy. The abdominal pygidial gland was seen to be very small with secretory cells arranged in a cup-like manner around a hollow interior and ducts opening out on the epidermis. The secretion of the thoracic pheromone glands was darkly-staining and openings of many of such glands were seen on the cuticle overlying the epidermal cells.

(c) Stored-product insects

In continuation to the earlier work of temperature controlling the population of pests of stored grains, the pupae and eggs of the grain moth (*Sitotroga cerealella*) and also the eggs of the rice moth (*Corcyra cephalonica*) were heated for 24, 48 and 72 hr duration at 35, 40 and 45°C during different developmental stages. Adult emergence was totally suppressed at 45°C and 40°C many of the emerged adults were sterile in *S. cerealella*. In case of eggs also at 45°C temperature there was complete failure of hatching in 24 hr old eggs while the eggs of advance age required long periods of exposure of heat to produce such an effect.

(d) Testing of the compounds

Barium metaborate dihydrate (BMBDH), conessine and extracts of the plant *Urena lobata* were tested for biological activities against the larvae of *Spodoptera litura*. Only BMBDH resulted in a dose-dependant mortality while other products were not effective.

Five compounds (RLJ-NE-472A, 472B, 499A, 449B and 435D) supplied by NPC Division were tested against *D. koenigii* and *S. litura* via their feed and found to be ineffective.

11 UTILIZATION OF CELLULOSICS

11 RC 01 Utilization of Lignocellulosic Materials

(a) Laminated hybrid composites

Lamination studies to further improve the strength and surface properties of composite boards were carried out. Particle boards made from cotton stalks were laminated with P.F. resin impregnated hesian sheets and glass tissue. Three grades of hesian sheets were used. Commercial particle boards were also laminated for comparison. In another set of experiments lamination was carried out during board formation in the press.

Table 8 : Evaluation of Laminated and Heat Treated Boards

Type of board	Density (g/cm ²)	MOR (kg/cm ²)	IB (kg/cm ²)	WA 34 h soaking (%)
<i>Commercial boards</i>				
Control (unlaminated)	0.75	106	8.4	75
Laminated both side	0.80	139	5.6	60
Heat treated	0.70	156	8.7	43
<i>Laboratory made boards from cotton stalks</i>				
Control (unlaminated)	0.76	144	8.8	88
Laminated both side during pressing	0.94	276	8.7	23
Heat treated	0.75	155	8.7	63

Some of the boards were given heat treatment. The laminated and heat treated boards were evaluated for modulus of rupture (MOR), internal bond (IB) and water absorption (WA) (Table 8).

(b) Medium density fibreboard (MDF)

Pulp from *Sarkanda* grass and cotton stalks was prepared by soda semi chemical and hydrothermal methods. The pulp was subsequently converted into MDF of 60 cm x 45 cm size. Blending of the two pulps was also carried out. MDF were made by wet method. In some cases P.F. resin and wax emulsion were also incorporated during MDF preparation. MDF prepared were evaluated for MOR, IB and water absorption.

(c) Organosolv pulping of Sarkanda grass

Organosolv pulps were prepared from *Sarkanda* grass, cotton stalks and eucalyptus under varying parameters. The pulps were evaluated for yield, Kappa number and in some cases strength properties of standard sheets prepared from the pulp. Organosolv pulp made from cotton stalk and eucalyptus at 170°C under pressure using ethanol and methanol without alkali gave; for cotton stalks 43.5-43.8% pulp recovery and Kappa number 85.0-89.9, and eucalyptus 45.4% pulp and Kappa number 75.6.

(d) Double stage pulping of Sarkanda grass

Aqueous prehydrolysis of *Sarkanda* grass prior to alkali digestion was tried for increasing pulp yield by soda pulping process. Sodium hydroxide

in combination with sodium sulphite was also tried. The pulps were evaluated for Kappa number, yield and breaking length (Table 9).

(e) Evaluation of composite boards

Number of boards viz. particle boards, fibreboards and MDF were evaluated for internal bond strength. The boards were exposed to 80% RH for one week and tested for MOR. Properties of cotton stalk particle boards after exposure to 80% RH are given in Table 10.

(f) Wood substitutes

Samples of composite and hybrid composite boards were made from *Lantana camara* and 'Sarkanda grass. The samples of composite boards were sent to CBRI, Roorkee for evaluation as wood substitutes. Demonstration model was also made from *Lantana* laminated board to show its use as almirah doors. The model was sent to PWD for evaluation.

(g) Recycling of industrial residues

Industrial residues such as hosiery cuttings and waste paper were recycled for making different grades of paper boards and high density thick board. The furnish consisting of different proportions of the two materials was studied for runnability over the pilot cylinder machine. The paper boards were evaluated for G.S.M. and breaking length in machine and cross direction. Breaking length of 3133 m was recorded in machine direction with 50:50 proportion. The experimental produce was converted

Table 9: Evaluation of Sarkanda Grass Pulp Prepared by Different Processes

Process	Yield %	Kappa No.	Breaking length m.
Soda	44.0	41.2	3638
Soda-sulphite	40.5	31.8	2435
Prehydrolysis Soda	48.7	69.4	1889

Table 10: Evaluation of Cotton Stalk Particle Boards

Property	Untreated	Heat Treated
MOR kg/cm ²	117	118 After exposure
80% RH for one week	33	70

into file covers. More than 9000 file covers were made and supplied for official use in RRL, Jammu, CSIR, New Delhi and other organizations.

(h) Lignosulphonates from non wood lignin

Further work on optimization of parameters for sulphonation of isolated lignin and lignin in black liquors was carried out. 'Sarkanda' soda liquor and soda-sulphite liquor were sulphonated using sulphur dioxide, sodium bisulphite and sodium sulphite. The sulphonated product was evaluated by UV spectrometer. The product was also examined for sugars, effect of pH, electrolyte and heat, and for foaming characteristics. Relationship of specific gravity and viscosity was studied. The results were compared with the commercial lignosulphonates.

OTHER R & D PROJECTS/INVESTIGATIONS

IN-HOUSE R&D PROJECTS, LABORATORY INVESTIGATIONS, NATIONAL MISSION PROJECTS AND EXTERNALLY FUNDED PROJECTS

IN-HOUSE R&D PROJECTS

01 IH 06 Adaptogens

(a) Adaptogenic activity

Plants coded 007, 044 and 054 have been studied for their adaptogenic activity. The parameters taken for ascertaining the anti-stress activity, have been the effect of the drugs on swimming performance, anti-fatigue and hypoxia. All these plants showed potent anti-stress activity on all the parameters, and therefore efforts are made to isolate the most active constituent responsible for this biological activity. As such number of fractions were prepared and biologically evaluated. Fraction RLJ-NE-519 (007) (B); RLJ-NF-424 (044) and RLJ-NE-518 (054) (A) repeatedly showed significant activity. These fractions were further fractionated and finally RLJ-NE-519 (007) (B) (d); RLJ-NF-424 (044) (f) and RLJ-NE-518 (054) A-3 from these plants have been identified as the most active constituents.

(b) RLJ-NE-97(003)

General pharmacological screening of this compound was carried out. It showed no significant change in BP, respiration, pulse rate in doses 10-50 mg/kg i.v. on isolated heart, there was no effect on rate, amplitude and out flow. On barbiturate potentiation, 200 mg/kg i.p. of the compound caused slight reduction in the hexobarbitone-induced sleep time. Its effect on CNS and acute toxicity when given both by i.p. and oral routes showed no effect on analgesia, body temperature and locomotor activity. ALD₅₀ is 1000 mg/kg both i.p. and p.o.

(c) Memory enhancing Drugs

Sub-fractions viz. RLJ-NE-621, RLJ-NE-675 and RLJ-NE-686 obtained by fractionation of 3 Ayurvedic herbs have been found useful for short

and long-term memory enhancement. These sub-fractions have been standardized on the basis of bioactive compounds present.

02 IH 05 Development and Standardization of Vegetative Propagation Techniques(Budding and Grafting) for Walnut (*Juglans regia* L.)

The seed stocks collected from different sources and sown in nursery in the laboratory farm at Sanat Nagar, Srinagar showed considerable variation in seedling height and collar diameter varying from 11-152 cm and 1.5-5.9 cm respectively. The seedlings also showed great variations in root characteristics and several other characters.

03 IH 01 Isolation and Characterization of Biologically Active Compounds from Medicinally Important Plants

Plant No.082

Different extracts were prepared from the ripe pods and the fractions RLJ-NE-570 and RLJ-NE-571 showed 53% and 33% anticomplimentary activity respectively. From the leaf extract of the same plant fractions RLJ-NE-572 and RLJ-NE-600 were obtained which displayed 86% and 30-70% anticomplimentary activities respectively.

Plant No.078

Fraction No.RLJ-NE-520 from the flower extract of the plant showed 80% anticomplimentary and 100% antiimplantation activity (175 mg/kg, antiestrogenic, LD₅₀ > 5 gm). Further fraction yielded RLJ-NE-639 which also displayed 100% antiimplantation activity.

Other Extracts

Apart from above plants different extracts of *Soymida acidum*, *Balanites aegyptiaca* and *Biophytum sensitivum* were also prepared (RLJ-NE-561 A&B, RLJ-NE-656 A&B, 454, 546). RLJ-NE-561 A&B was found to possess marked CNS depressant activity.

Plant No.079

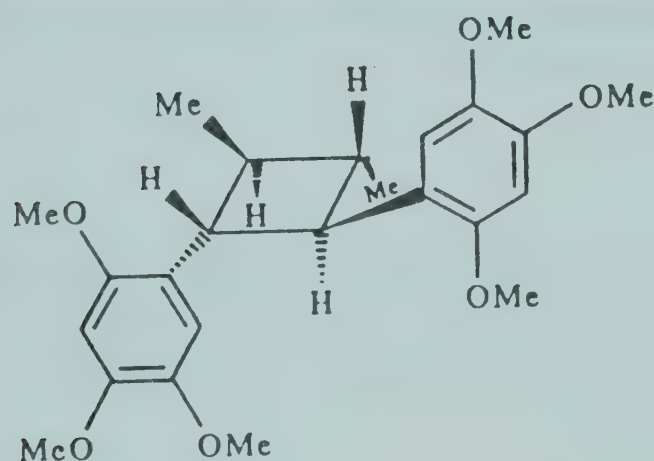
Stem and leaf of the plant were subjected to fractionation in different organic solvents. 10 fractions viz. RLJ-NE-538 (1 to 10) were prepared and subjected to anti-feedant activity. Two fractions No. 2 and 6, showed high anti-feedant activity. These fractions were further subjected to repeated column chromatography and four most active fractions viz. RLJ-NE-538 (6)-89-III, VI & VII and RLJ-NE-538(6) 10 (II) were separated.

Plant No.069

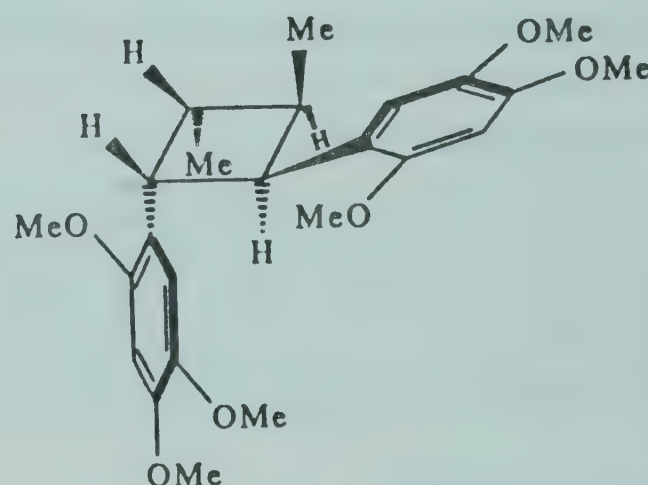
Leaf extract of 069 was fractionated into the fractions RLJ-NE-487A, 487B, 487C and 487D. The fraction RLJ-NE-487B showed significant immunostimulant activity. Column chromatography of the active fraction gave three pure substances.

New Compounds

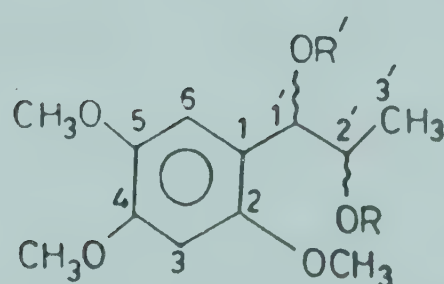
Reassignment of structure of new neolignan isolated from *Piper sumatranum* namely 1α , 2β , 3α , 4β or 1β , 2α , 3β , 4α 1,2-dimethyl-3,4-bis (2,4,5-trimethoxyphenyl) cyclobutane has been revised to 1α , 2β , 3β , 4α -1,2-dimethyl 3,4-bis (2,4,5-trimethoxyphenyl)-cyclobutane and structure of magnosalin now isolated from *Piper clusii* has been revised to 1β , 2α , 3β , 4α -1,2-dimethyl 3,4-bis (2,4,5-trimethoxyphenyl) cyclobutane by single crystal X-ray crystallography. Further more from the petrol extract of fruits of *P. clusii*, three new phenylpropanoids viz. 1-(2,4,5-trimethoxyphenyl)-1,2-dihydroxypropane, 1-(2,4,5-trimethoxyphenyl)-2-acetoxy-1-hydroxypropane and 1-(2,4,5-trimethoxyphenyl)-1,2-diacetoxy propane were isolated together with a new sesquiterpene enantiomer (-) ledol structure of which was assigned on the basis of 2D NMR spectroscopy.



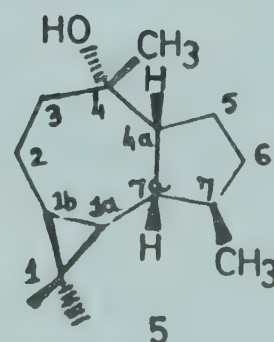
1 Magnosalin



2 Andamanicin



- 1 $R = R' = H$
- 2 $R = COCH_3, R' = H$
- 3 $R = R' = COCH_3$
- 4 $R = CH_3, R' = H$



(-) Ledol

Fig. 3

The petrol extract of *P. sumatranum* furnished a new phenyl propanoid viz. 1-(2,4,5-trimethoxyphenyl)-1-hydroxy-2-methoxy propane.

03 1H 05 Utilization of abundantly available resin of *Shorea robusta* and *Vateria indica*

Pyrolysis studies were conducted on both the resins at 300-350°C to yield oils having leathery odours. Preliminary analyses revealed that the oil from *Shorea robusta* was rich in cadinene isomers and its derivatives. Some diterpenoids were found to occur in the pyrolysed oil. The oil obtained from pyrolysis was found to be highly complex and so it was subjected to the action of various chemical agents *i.e.* Cr₂O₃, KMNO₄, H₂O₂ and hydration with sulphuric acid. The products of these reactions were found to have better odour than the starting material. Further studies are in progress.

Utilization of Menthone from Thymol production

Menthone, a byproduct of the menthol industry is available in large quantities in the country and finds less use as such. It is a cheap starting material for the manufacture of Thymol. A chemical process for the manufacture of thymol has already been worked out. Work is now going on a catalytic process for this conversion and in this regard a batch process has been completed on a 500 g scale. The process is now being finalised for the commercial production. Work is also going on a vapour phase catalytic process. In this regard a number of catalysts are being screened to get the maximum yield with minimum side products.

Studies on the chemical composition of Tagetes minuta oil at various stages of Flowering and Fruiting

The chemical composition of Indian *Tagetes minuta* oil was determined at different development stages of plant growth using GCMS. ¹H NMR & ¹³C-NMR spectroscopy. In contrast to previous results, the characteristic compounds of the Indian oil were (Z)- β-ocimene, (Z)-tagetone, (E)-tagetone, (Z)- & (E)- tagetenones and dihydrotagetone. The percentage composition of these constituents changes with flower maturation. The dihydrotagetone percentage declined sharply from flower buds (48.09%) to seed shedding stage (11.90%) with a simultaneous rise in (Z)-β-ocimene (35.3%), (Z)-tagetone and (E)- tagetenone (26.4%) at the time of immature fruit formation, suggesting that dihydrotagetone may be biogenetically changed into (Z) & (E) - tagetenones. Chemical investigation on other aromatic plants is being continued:

Elsholtzia species; Ferula species; Angelica species; Ocimum species.

08 IH 01 Development of Backward Areas

a) Toxicological studies

i) Effect of domestic sewage on respiratory activities of fishes was studied on *Puntius sophore*. Varied concentrations of domestic sewage (20%, 40%, 60%, 80% and 100%) were made with tube-well water. A control was also run simultaneously. At 20%, 40%, 60%, 80% and 100% conc. the opercular beats recorded were 150/min, 156/min., 165/min, 170/min and 174/min. respectively. However, in control fishes the opercular beats were 132/min. This clearly indicates that with the increase in sewage concentration, there is fast opercular movement and increase in number of beats.

ii) Influence of urea on the feeding rate of fish *Cyprinus carpio* was studied under two selected temperatures i.e. $20 \pm 1^{\circ}\text{C}$ and $30 \pm 1^{\circ}\text{C}$. Concentration of urea was from 20 ppm to 200 ppm. In each container 2 fishes were placed and live chironomid larvae (100 Nos.) were provided after every 24 hr. The number of larvae consumed by fish was observed and recorded. Results show that at $20 \pm 1^{\circ}\text{C}$ fish did not show any significant change in feeding. However, at $30 \pm 1^{\circ}$ an increase in feeding rate was observed from 20 to 100 ppm. Thereafter, a decrease in the consumption of larvae was observed.

(b) Bacteriological studies

i) Pathogenecity of bacterial isolates on the exposed skin of *Channa punctatus* was done by giving infection of *Aeromonas sobria*. *A. sobria* was first inoculated in peptone water and the counting of bacterial cells/ml was done after dilution. The skin from the head and body region was ex-

Table 11: Pathogenecity of four bacteria on *Puntius sophore*

Pathogen	Dose	% Mortality				Infection Developed
		24	48	72	96	
<i>A. punctatus</i>	$2.5 \times 10^{10}/\text{ml}$	50	75	75	100	Furncle developed within 24 hr.
<i>A.sobria</i>	$9.35 \times 10^9/\text{ml}$	-	50	75	100	Furncle developed within 48 hr.
<i>A.hydrophila</i>	$6.87 \times 10^{10}/\text{ml}$	-	50	75	100	Tail rot within 72 hr.
<i>Y.enterocolitca</i>	$9.5 \times 10^{10}/\text{ml}$	50	75	100	100	Haemorrhages after 72hr.

posed and the infection of *A. sobria* (4×10^6 /ml) was given by pouring the bacterial suspension directly on the exposed tissue. No mortality was recorded upto 14 days and it was 50% after 18 days of inoculation of *A. sobria*.

ii) Pathogenecity of four bacteria i.e. *Aeromonas hydrophila*, *A. punctata*, *A. sobria* and *Yersinia enterocolitica* on *Puntius sophore* was studied. Intramuscular injection of 0.5 ml of bacterial isolates was given to each experimental fish at caudal peduncle and the results were recorded upto 96 hr to determine the LC₅₀ and LC₁₀₀ (Table 11).

iii) MPN coliform count

Seasonal study of coliform count of R.R.L. pond was done. The results were recorded for both acid and gas production as per McCarty chart. MPN count ranges from 900+ to 1800+ from January to December, minimum being in the month of November and December and maximum from March to July.

LABORATORY INVESTIGATIONS

I. Economic Plants Grown in Jammu Province

(a) *Vernonia galamensis*

Two American and one Zimbabwe collection of *V. galamensis* were trial cultivated and evaluated for growth performance, seed yield potential, oil content and vernolic acid composition. The American collections grew 48-62 cm at maturity and recorded 30-32% seed oil with 70-73% vernolic acid. The accession from Zimbabwe was taller (78 cm) with moderately lower levels of oil (28.3%) and vernolic acid (64.5%).

(b) *Vernonia anthelmintica*

One of the promising selections developed from EC-165038 possessed following :

Oil attributes	
Saponification value	185.7
Iodine value	92.0
Unsaponifiable matter	3.2

Fatty acid composition	(%)
Lauric acid	2.13
Myristic acid	0.42
Palmitic acid	0.30
Stearic acid	0.40
Oleic acid	5.65
Linoleic acid	15.8
Vernolic acid	70.3

(c) *Anethum graveolens* (Dill)

Character association and path-coefficient analysis of Dill (*Anethum graveolens*) was studied on the nine exotic collections raised at RRL, Jammu. Results revealed that accession, imbonxja and sukullus were found more suitable for exploitation in selection of high yielding plant types.

(d) *Tagetes erecta*

The germplasms collected from Badaun (U.P.), Nagrota (Jammu) and a local one were studied for flower yield and xanthophyll contents. On the preliminary screening the collection obtained from Nagrota produced more number of flowers, size of flower, number of petals and flower weight per plant. Inter and intra row spacing of 70 cm x 45 cm yielded about 38 Qtls of fresh flowers and 1.9 Qtls dry petals per hectare. Out of the three collections the Nagrota collection also yielded higher xanthophyll content.

(e) *Asparagus*

The work on cultivation of asparagus was taken up in Jammu province in view of the disturbed situation in Kashmir valley. All plants grew satisfactorily until December, 1992 and regrew again in February, 1993. The plants are due to be harvested in April, 1995. No differences have yet been detected in plant survival or basal fern.

Due to extension work conducted by the Laboratory 150 growers (including 7 new growers) produced about 95 tonnes (valued at Rs.37 lacs of asparagus during the year. Seed and printed literature was supplied to Bidhan Chandra Krishi Vishwa Vidyalaya College of Agriculture, Himachal Pradesh Krishi Vishwavidyalaya (HPKV), Palampur, Central Potato Research Institute, Shimla, Krishi Gramvikas Kendra, Ranchi, M/S

Grasim Industries, M.P., M/S Aman Floritech; Chandigarh and Jeysons Laboratories, Jammu.

II. Introduction of selected species of economic importance in Kashmir valley

(a) *Ginkgo biloba*

The trial cultivation of this plant has been laid out. Studies on various parameters are under observation. The plant is reported to possess immune modulator, lung-astringent, antiasthmatic, enuresis quenching and antileukorrheal activities.

(b) *Platanus orientalis* (Chinar)

Experiments are being conducted to find out fast vegetative propagation techniques. Different types of cuttings pretreated in rooting hormones were used and approximately 1000 rooted saplings of this tree species have successfully been raised in the first phase for its onwards distribution to the concerned agencies.

III. Chemical Investigations

(i) Plant No.008 : A non-phenolic fraction obtained from the n-BuOH extract has been isolated possessing over 90% anticomplementary activity.

(ii) Plant No.088 : A bench scale process for the azadirachtin rich fraction has been developed.

(iii) Taxol : Different portions of *Taxus baccata* plant viz. shoots, leaves, wood and bark were extracted. Separation of different compounds from the extract such as taxol, cephalomannine and 10 deacetyl-baccatin was carried out by HPLC. Bark contains taxol in the range of 0.02-0.027% on dry weight basis. Needles of *T. baccata* collected from different areas and seasons were also analysed for taxol, cephalomannine (Taxol-B) and 10-deacetyl-baccatin-III.

A process for the isolation of 10-deacetyl-baccatin-III, a precursor of taxol has been developed to give yield of 0.02%.

(iv) Podophyllotoxin : Podophyllotoxin was isolated from *Podophyllum hexandrum*. Isolation of its glycosides was carried out from its aqueous extract. Four fractions were separated for characterisation and identification.

(v) Evaluation of materials for trimethoxy benzoic acid : Tannin rich materials such as *Terminalia belerica*, pomegranate rinds and tea tannins were evaluated for 3,4,5-trimethoxy benzoic acid. Elemicin oil was dis-

tilled from Elerosa grass and the oil was separated into phenolic and non-phenolic fractions. The phenolic portion was isomerised into isoelemicin which on oxidation yielded 3,4,5-trimethoxy benzaldehyde. The parameters of the process were worked out.

(IV) Production of glucose oxidase as an indigenous source for its use as glucose sensor

A modified process for large scale production and isolation of glucose oxidase from submerged cultures of *Aspergillus niger* was developed. The process is efficient due to three fold increased yields of the enzyme obtained under specified controlled fermentation conditions. The isolation of the enzyme has been simplified and a purified preparation with specific activity of 90,000 sigma units g⁻¹ protein is obtainable with the modified process.

(V) Utilization of Minerals

(a) Phase Transformations in Al(OH)₃ gel

The phase transformation studies were carried out in aluminum hydroxide gel aged for different lengths of time (10,25,50,100, 200, 340 days). It was observed that at 300°C, the 10 & 25 days aged gel transformed to Chi-alumina. But in samples aged for a period of 50 days very diffuse lines of boehmite phase appeared in X-ray diffractogram, in addition to the di-alumina reflections. With the further increase of ageing period the well developed reflection of boehmite appeared especially in samples aged for a period of 340 days. Further heating at higher temperatures upto 1000°C transformed the samples to their subsequent phases. The crystallite size determination of these samples was also carried out applying Scherrer's equation to the integrated intensities of the basal reflections.

(b) Manufacture of Precipitated CaCO₃ and Basic MgCO₃ from Dolomitic limestone of Jammu

Work was carried out with the available obsolete furnace by introducing a change in its inner atmosphere with a view to reduce the temperature of calcination which gave very encouraging results. It is now proposed to arrange fabrication/purchase of a new furnace for exact results. Similarly, a modification of the available autoclave for reaction under controlled temperature provided further improvements to the recarbonation studies. It is now proposed to arrange modification of available bigger capacity autoclave (50 lit/batch) for larger experiments.

(c) Granites, sandstones and others

Samples of sandstones, shales, dolomitic limestone, traps, granites schist and Gneisses were collected from different areas in Jammu Province of J&K State, which were cut with Edge Cutting Machine. The cut samples obtained appear to have a good potential for a number of Industries in the region, which is being explored.

NATIONAL MISSION PROJECTS

Bharatia Jan Gyan Vigyan Jetha-92

This project was sponsored by National Council for Science and Technology Communication, Govt. of India (NCSTC). Various activities undertaken in this programme were:

(i) Celebration of nutrition week

During national nutrition week (1st to 7th September, 1992) a number of programmes were organised in different parts of Jammu Province to create mass awareness among the masses of rural and backward border areas about the importance of nutrition for better health. The main features of the week were organising of essay competitions, quiz programmes, poster exhibitions, baby shows, health checkup and immunisation, video shows, slide and film shows alongwith lectures and demonstration on low cost nutrition diets in some villages. In this programme, Food and Nutrition Unit (Govt. of India), ICDS and Health Department of J&K actively participated.

(ii) Training programme on composite fish culture

One day training programme on composite fish culture was organised at R.S.Pura of District Jammu on 29th September, 1992. This training programme was attended by 30 participants. In this programme farmers were motivated about the fish culture and proper utilization of their village ponds for the production of animal protein.

(iii) Science communication through live entertainment

This workshop was conducted from 13th to 17th October, 1992 at RRL, Jammu. In this workshop 29 youths from 6 districts namely Jammu, Udhampur, Kathua, Doda, Poonch and Rajouri were trained on the main themes of BJGVJ *i.e.* health, water, environment, family planning, literacy etc. The other participating agencies in this programme were: Song and Drama Division of Ministry of Information and Broadcasting, Govt. of India and Nehru Yuva Kendras.

(iv) Software training workshop

Two days training workshop on software was organised at RRL, Jammu from 19th to 20th October, 1992. 15 trainees from 6 districts (Jammu, Kathua, Udhampur, Doda, Poonch & Rajouri) of Jammu province participated in this workshop. During workshop, posters, charts, booklets, slides and video films on various themes of BJGVJ like, health, water environment, technology for people, literacy etc. were shown to participants. Departments of Rural Sanitation & Health of J&K, Department of Information and Broadcasting, ICDS, Food and Nutrition Unit, Govt. of India and Department of Adult Education, University of Jammu participated in this programme.

(v) Explaining miracles by science

2 days training workshop was organised from 22nd to 23rd October, 1992 at RRL, Jammu on explaining miracles by science. 12 participants from 6 districts of Jammu participated in this workshop. Resource persons from NCSTC, Govt. of India performed and explained the background of various tricks to the trainees.

(vi) Main Jetha coverage

Main Jetha was organised in all districts with the help of Nehru Yuva Kendras. The other collaborating departments' agencies in this main Jetha were: District Administration, D.R.D.A., Rural Development, Rural Sanitation, Health, Information, and Education Departments. In each district 10 to 15 trained youths organised programmes about the main objectives of BJGVJ through exhibition, video & slide shows, songs and skits. Rallies were also organised in each block during the Jetha.

The Jethas were launched as under:

Date of start	District	Starting village	No. of village covered	Day taken
14.11.92	Kathua	Chingi Makwal	110	40
14.11.92	Udhampur	Mansar	60	45
14.11.92	Poonch	Tarakundi	70	30
20.11.92	Jammu	Nikkian	70	45
8.12.92	Rajouri	Seri	45	40

EXTERNALLY FUNDED PROJECT

Demonstration and Development of Bio-fertilizer Based on *Rhizobium* sps. for Various Cultivars of *Phaseoli* (Sponsored by the Department of Biotechnology, Govt. of India, New Delhi)

As a part of DBT-sponsored long term national project on the development of Bio-fertilizers, fermentation studies at pilot scale bioreactors were conducted.

Lignite carrier based biofertilizers for a number of *Rhizobium* species were developed and demonstrated at field station in and around Jammu.

Selection of new and more efficient *Rhizobia* for various agro-climates was made . A protein finger print technique was developed for the quick selection of efficient and active nodulating strains of *Rhizobia* species.

Steroid Transformation

(Sponsored)

The precursor 16-methyl - Delta^{1,4} - pregnadiene-17,21-hydroxy-3-20-dione was treated with *Aspergillus* sp. RRL-123 in shake flasks in various concentrations. It has been observed that 2 mg/ml of the substrate can be successfully transformed into its 16-methyl- Delta^{1,4} pregnadiene-11, 17, 21 -trihydroxy -3- 20-dione within 48 hrs. of incubation time. The product has been isolated and NMR and mass spectroscopy confirmed its structure. The yield was in the range of 80-90%.

Utilization of Geothermal Energy

(Sponsored by the Department of Non conventional Energy)

Sources, Govt. of India, New Delhi

One of the major problems being faced at Puga is chocking of geothermal wells, which was studied in detail. Attempts for chemical treatment of wells for cleansing did not succeed. A method was developed in which chemically treated chocked geothermal well was cleaned by mechanical means. For mechanical means also a device requiring little inputs was designed and fabricated which proved very successful during field trials in Puga.

INFRASTRUCTURE

CHEMICAL ENGINEERING & DESIGN

1. Turn-key Projects

(a) Setting-up of Aroma Chemicals Plant at Vinarom-Ho Chi Minh City, Vietnam through UNIDO, Vienna

This Laboratory had been retained by United Nations Industrial Development Organisation (UNIDO) to design and fabricate a multipurpose plant on turn-key basis for the manufacture of various aroma chemicals. The plant has capacity to process 100 kg of crude essential oils to produce pure geraniol, citronellol etc. The plant can also process 100 kg of turpentine oil to obtain α , β pinenes and terpeniol.

This plant was completely designed by our scientists and engineers alongwith its flow-sheeting, process layout and structure design. After checking the plant in all aspects like hydraulic testing, piping lay-outs, structure modifications, it was dismantled, packed and shipped to Vietnam where it will be finally installed and commissioned by RRL engineers in April-May, 1993.

(b) Commissioning of 16-DPA Plant at Gairibas (West Bengal)

Directorate of Cinchona and Other Medicinal Plants, Govt. of West Bengal has retained this Laboratory for setting up a plant on turn-key basis to manufacture 16-DPA from diosgenin. The plant has a capacity to produce 1.8 tonnes of 16-DPA (*i.e.* to process 4 tonnes of diosgenin) per annum.

In February, 1990, the plant was installed at Govt. Diosgenin Factory, Gairibas, Distt. Darjeeling (West Bengal). Few trial runs were also conducted at that time. This plant was formally commissioned by our engineers and technicians in July, 1992. The plant has started regular production since then. Comprehensive training was imparted to the staff employed in this factory in operation and maintenance of the said plant as well as testing and quality control of raw materials and final products.

2. Process Development

(a) Desalination of water by thermally regenerable Ion Exchange resins

The project has the objective of finding cheaper method of desalination of brackish water by Ion Exchangers. Chemical regeneration being costly and environmentally hazardous, thermal regeneration of Ion Exchange resins was found to be cost effective and free of effluents.

Wide ranging experiments with weakly acidic and weakly basic Ion Exchange resins were conducted. Mixed bed resins were found suitable in case of sorption and thermal regeneration. Results of water purity upto first five cycles of sorption and thermal regeneration were upto the mark. Efforts are being made to make this process commercially viable.

(b) Concentration of calcium gluconate

Calcium gluconate broth from fermentation was concentrated in wiped film evaporator to recover calcium gluconate under vacuum. The processing was done in collaboration with Microbiology Section of this Laboratory.

(c) Development of drug intermediates

(i) *Methoxy-phenylacetic acid*: This acid has been prepared from amisol and acetophenone. Yield of 56% has been obtained where as efforts are being made to increase the yield to 60-65%.

(ii) *Iodobenzene*: This has been prepared from iodine and benzene. 80% yield has been achieved. Efforts are being made to increase yield further to 90%.

(d) Rosin and turpentine derivatives

Process for the manufacture of methyl esters of rosin has been developed.

(e) Sesame processing unit

A unit having capacity of 350 kg/batch of processing *Sesamum indicum* has been designed.

(f) Isoconazole nitrate unit

Production unit having capacity of 1 kg/hr. has been designed.

(g) Post Harvest Technology for Wild Pomegranates

A continuous machine in collaboration with Food Technology Division has been developed for separating pomegranate seeds from its skin. The capacity of the unit is to process 60 kg of 75 mm dia pomegranate fruit per hour.

3. Consultancy Projects

M/S Himalayan Extracts Pvt. Ltd., Chandigarh has retained this Laboratory under Engineering Consultancy Scheme to prepare Project Report for the processing of essential oils like Jamrosa and citronella. The following was supplied to the party.

Complete project report consisting of design drawings of equipment, process profile & cost estimation, list of plant equipment and machinery, specifications of bought-out items, raw material, utilities and manpower requirements, has been handed over to the party.

WORKSHOP

1. Setting-up a Solar-cum-Agrowaste Drier on Turn-key Basis

The Laboratory has been awarded the work of fabrication, installation and commissioning of a Solar-cum-Agrowaste Drier for drying of Toria seeds under T.M.O. & P.Mission Project. The work is sponsored by Ministry of Agriculture. The estimated cost is Rs. 10 lacs. This work was taken up in December, 1992. All the bought-out items like bucket elevator, blowers etc. have been received and fabrication work has been completed. Installation work is under progress and is likely to be completed by June, 1993. The drier will be tested in the next Toria harvesting season *i.e.* December, 1993.

2. Hops Drying Kilns for Govt. of Himachal Pradesh

A 6 tonnes per day capacity hops drying kiln fabricated in our Workshop was installed and commissioned at Shansha, Keylong (Lahual Valley) for Govt. of Himachal Pradesh. Repeat order for a similar type of kiln has been received from Directorate of Horticulture, Govt. of Himachal Pradesh. The design drawing work of this unit has been completed and the fabrication work of the kiln will be taken up from June, 1993, which will be installed at Waring (Lahaul Valley).

3. Repair, Maintenance & Fabrication Jobs

The Workshop completed the following repairs, maintenance & fabrication jobs during the period under report:-

Mechanical	:	444 Nos.
Fabricational	:	11 Nos.
Electrical	:	1643 Nos.
Refrigeration	:	186 Nos.

INDUSTRIAL SURVEY

Project monitoring and evaluation

Projects were planned, drafted and their progress was monitored from time to time and project reports were presented to concerned agencies. Detailed Annual Plan Budget alongwith 8th Five Year Plan document were prepared. Activity milestones for selected projects were defined and sent to CSIR.

Training programme

Training of 30 students of BITS, Pilani, different R.E.C.'s and other institutions was coordinated.

Liaison

Close liaison was maintained with different entrepreneurs/ Govt. agencies and Public Sector Undertakings. Various processes developed by this Institution were brought to the notice of these organisations. Queries received from different private parties/Govt. organisations were promptly replied and updated information was supplied to them. Regular liaison was maintained with other disciplines of the Laboratory.

Photography

Photographs taken of various research activities training programmes, seminar and symposium (black & white and colour)	1468
Enlargement made of various sizes	2540
Projection slides (colour, B&W)	250

Art

Ink drawings of plants & herbarium sheets	15 Nos.
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Charts of different sizes	243 Nos.
Graphs and curves	210 Nos.
Histological drawings	18 Nos.
Map	1 No.

Exhibition

Participated in an exhibition held at Mandi (H.P.).

INSTRUMENTATION

A. Analytical data service

The analysis report of samples during the year with the sophisticated analytical instruments is tabulated as under:-

Instrument	No of samples
FT-NMR spectrometer	
i. H ¹	621
ii. C ¹³	70
NMR spectrometer T-60 A Varian 60	
Mass Spectrometer Shimadzu	
GC	71
MS	606
UV/Vis Spectrophotometer	
Kinetic	546
OD	8828
Spectra	500
Infra Red spectrophotometer Shimadzu	435
Dichrograph (CD/ORD)	45
HPLC (Gilson)	842
Gas chromatograph	939

B. Repair/Maintenance

The sophisticated analytical instruments of the Section as well as electrical and electronic instruments installed in other sections are repaired/maintained by the staff of the Section like:

- (i) DNA Transilluminator, spectrophotometer
- (ii) Droplet Counter Chromatograph
- (iii) Beta counter
- (iv) Computers
- (v) Growth chambers
- (vi) Oil pumps, centrifuges, Microfuges, fermenters etc.

C. Other activities

i) Computer service is being rendered for scientific and administrative works such as application, software development, paybills for RRL Staff & information system.

ii) Practical Training in Electronics/Computers was imparted to 9 B E students of various universities.

iii) Samples testing facility was provided to: (a) M/s Hindustan Lever & (ii) Jammu University.

iv) Freeze drying facility is added for drying the heat sensitive extracts provided by the scientists.

v) Audio- visual facilities were provided by the Section on functions organised by RRL, Jammu/other organisations.

TECHNICAL CELL AND LIBRARY

Publications and Information

a) Publications

RRL, Jammu Annual Report 1991-92

RRL Newsletter Nov.19 Issue 2-4, Pages 12.

b) Publicity, Sale and Distribution of Publications

(i) Books

Cultivation & Utilization of Medicinal Plants

Cultivation & Utilization of Aromatic Plants

Indian Mushroom Science-II

Chemistry and Pharmacology of Vasicine - A new oxytocic and Abortifacient.

RRL Jammu Silver Jubilee Commemorative Lectures

(ii) Monographs

Himalayan Heracleum Linn. (Hogweed) - A Review

Ergot Production in India

Cultivation of Asparagus

(iii) Survey Reports

Essential Oil and Perfumery Industry in North India

Rose and Rose Oil Industry in India

(iv) Technical Folders

Cultivation of Hops

Cultivation of Lemongrass

Cultivation of Jamrosa

(v) Periodicals

RRL Newsletter }

}

Current and back issues

Annual Report }

(c) Other Technical Activities

i) Processing of RRL Publications

During the year manuscripts of forty research papers of RRL scientists were processed through Publication Committee.

ii) Write-ups related to RRL activities for publication in CSIR News and other publications/directories.

iii) Printing jobs of technical nature in respect of other activities like Foundation Days (CSIR and RRL,Jammu), Flower Show etc.

iv) Technical enquiries related to R&D activities of the Laboratory.

Library

(i) Coliection development

Additions during the period and total holdings as on 31.3.1993 are given below:-

Type of documents	Additions	Total Collection
Books	70	15189
Bound Journals	176	18756
Standard specifications	5	1429
Photocopies & Translations	73	1712
Annual Reports	33	1312
Pamphlets	14	612
Maps & Atlases	-	140
Technical films	-	11
Microfiche	6	3

(ii) 261 Journals were received both at Jammu and Srinagar, out of which 195 were subscribed and remaining received gratis/exchange. New subscriptions taken out are as under:-

Review of Plant Pathology, London

Journal of Carbohydrate Chemistry, New York

MIMS - India

(iii) 150 reprints of papers published by staff were distributed to various scientific workers on request.

(iv) Services

Besides S&T staff of Jammu, Srinagar and Palampur, the Library continued to extend reference and consultation facilities to persons from industries, Govt. departments, research scholars from local university and colleges. During the period 1170 external users consulted Library resources.

APPENDICES

APPENDIX-I

PUBLICATIONS

A) REVIEWS

Champagne, D.E., Koul, O., Isman, M.B., Scudder, G.G.E and Towers, G.H.N. - Biological activity of limonoids from rutales; *Phytochem.*, **31**, 1992, 377-94.

Johri, R.K. and Zutshi, U.- An ayurvedic formulation "Trikatu" and its constituents; *J.Ethnopharmacol.*, **37**, 1992, 85-93.

Kak, S.N.- Role of biotechnology in the development of perfumery, flavouring and cosmetic chemicals; *Perfumeric Kosmetik*, **73**, 1992, 474-75.

B) PAPERS

Anand, K.K., Gupta, V.N., Rangari, V., Singh, B. and Chandan, B.K.- Structure and hepatoprotective activity of a biflavonoid from *Canarium manii*; *Planta Medica*, **58**, 1992, 493-95.

Bakshi, S.K. and Kitchlu, S.- Chromosome studies in a wild male hop (*Humulus lupulus* L.) from Kashmir; *The Nucleus*, **35**, 1992, 111-13.

Balyan, S.S. and Singh, A.- Effect of different levels and time of pruning in *Ocimum gratissimum* Linn. (Var. Clocimum); in book- *Recent Advances in Medicinal, Aromatic and Spices Crops*, S.P. Raychoudhuri (Ed.), Today & Tomorrow's Printers and Publishers, New Delhi, **Vol.2**, 1992, 427-30.

Bansal, G.L., Nayyar, H. and Bedi, Y.S. - Allelopathic effect of *Eucalyptus macrorhyncha* and *E. youmanii* on seedling growth of wheat and radish; *Indian J. Agri. Sci.*, **62**, 1992, 771-72.

Bhatia, A.K., Singh, R.P. and Gupta, A.K.- Juice cocktails from tropical fruits and tart apples; *Beverage & Fd. World*, **19**, 1992, 22-23.

Bhutani, K.K., Gupta, D.K. and Kapil R.S. - Occurrence of D/E trans stereochemistry isomeric to ursane (cis) series in a new pentacyclic triterpene from *Calotropis procera*; *Tetrahydron Letters*, **33**, 1992, 7593-96.

Buse, R., Qazi, G.N., Onken, U.- Influence of constant and oscillating dissolved oxygen concentrations on keto acid production by *Gluconobacter oxydans* subsp. *Melanogenum*; *J.Biotechnol.*, **26** (2-3), 1992, 231-44.

Buse,R., Onken, U.,Qazi, G.N.,Sharma, N.,Parsad,R. and Verma, V.- Influence of dilution rate and dissolved oxygen concentration on continuous keto acid production by *Gluconobacter oxydans* subsps. *Melanogenum*; *Enzyme Microb. Technol.*, **14**, 1992,1001-1006.

Choudhary,D.K. and Kaul,B.L.- Genetic parameters of Celery (*Apium graveolens* L.); *Indian Perfum.*, **36**, 1992, 297-99.

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Pandita, P.N. and Kaul, Kiran - Jerusalem Artichoke; *Kisan World*, **19**, 1992, 42-43.

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Environmental Mutagens Society of India : National Seminar on -'Environmental Mutagens and Carcinogens, 'held at Poona from April 20-23, 1992.

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American Society of Pharmacognosy: 33rd Annual Meeting held at Colonial Williamburg, Virginia (USA) from July 26-31, 1992.

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Indian Society of Pharmacognosy : National Seminar on Herbal Products, held at Baroda on September 29, 1992.

Singh, J.- Trends in commerce of herbal products. (Invited Lecture)

International Congress of Flavours, Fragrances and Essential Oils: 12th Congress held at Vienna from Oct. 4-8, 1992.

Bradu,B.L.- Evaluation of lignin synthesis in relation to essential oil and eugenol contents in Clocimum (*Ocimum gratissimum*).

Kak,S. N. and Kaul,B.L.- Biotechnology of essential oils and aroma chemicals.

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Jain, S.M., Khajuria, R.K., Kapil, R.S., Bhan, L.K., Ogra, R.K., and Chowdhary S.K. - Silk enhancer from *Cassia tora* for *Bombyx mori* L.

Indian Pharmacological Society: Annual Conference, held at Muzzafarpur (Bihar) from December 5-8 1992.

Pahwa, G.S., Sharma, S.C. and Zutshi, U. - Effect of sex hormones status on the rifampicin bioavailability.

Thusu, N., Pahwa, G.S., Sharma, S.C. and Zutshi, U. - Modulation of mice hepatic - glutamyl transpeptidase activity by thyroid hormones.

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Indian Chemical Engineers Congress : 45th Annual Session of *CHEM-CON-92*, held at Manipal from Dec 19-22, 1992.

Gandotra,B.M., Kaul,V.K., and Tikoo,C.L.-Manufacture of re fined rutin.

Kaul,V.K., Gandotra,B.M., and Tikoo,C.L.-Steam distillation and fractionation of essential oils.

Society of Biological Chemists : 61st Annual Meeting, held at Hyderabad from December 21-23,1992.

Singh,J., Jamwal,D.S.,and Reen,R.K.- Piperine from black pepper : A potent inhibitor of NAD/NADH dependent dehydrogenase.

Indian Society of Agricultural Biochemists, C.S.Azad University of Agriculture and Technology , Kanpur & Division of Biochemistry (IARI,New Delhi) : International Conference on *-Biotechnology in Agriculture and Forestry*, held at New Delhi from February 15-18, 1993.

Ahuja,A., Kaul,S. and Kaul,B.L. - Somatic embryogenesis in saffron (*Crocus sativus* L.): Recent findings and prospects.

Mukesh Mohan , Ahuja,A. and Chowdhary,S.K.-Biotechnology in sericulture: potential and challenges.

Indian Society of Plant Physiology; National Conference on- *Plant Physiology on the Advances in Molecular and Plant Physiological Researches in Crop Improvement*, held at Faizabad from February 22-25, 1993.

Kaul, Kiran - Comparative effects of Gibberellic acid , kinetin and Fusecoccin on the growth and activity of certain enzymes in isolated cucumber cotyledons.

Panjab Agricultural University (Ludhiana) : International Symposium on - *Heterosis Breeding in Crop Plants-Theory and Application*, held at Ludhiana from February 23-24, 1993.

Khosla, M.K.-Heterosis in interspecific crosses of *Ocimums*.

PROCESS DEVELOPED / PROCESSES RELEASED / CONSULTANCY / SPONSORED PROJECT

A. Patents Filed

Author	Title
Metha, S.K. Sayanam, R.A., Johar, P.S. Khajuria, H.R.	A process for making composite material using gypsum and agro-waste materials useful for building material.
No.155/DEL/90 dated 22.2.90	
Bedi, K.L. Zutshi, U. Kapoor, N. Kaul, J.L. Bano, G.	A process for the preparation of a pharmaceutical composition with enhanced activity for the treatment of vitilgo, psoriasis & mycosis & fungoides.
No.368/DEL/91 dated 26.4.91	
Suri, A.K. Upadhayay, J.M. Mehta, S.K.	An improved process for the preparation of boron trifluoride diethyletherate.
No.908/DEL/91 dated 25.9.91	
Upadhayay, J.M. Mehta, S.K.	A process for the treatment of used hydraulic binders(cements) & their aggregates to make them reusable.
No.909/DEL/91 dated 25.9.91	
Hajela, Kanchan Kapil, R.S.	A process for the synthesis of novel 2-(alkoxyphenyl-3-(substituted phenyl)-7H/hydroxy/alkoxy/alkyl-2H-1-Benzopyrans.
No.1141/DEL/91 dated 22.11.91	

Suri, J.L.
Dhar, K.L.
Kapil, A.
Kapil, R.S.

A process for the isolation of an immunostimulating agent from the leaves of the plant *Vitex negundo*.

No.777/DEL/92
dated 1.9.92

Suri, K.A.
Suri, O.P.
Sharma, M.L.
Satti, N.K.
Khajuria, Anamika
Kaul, Anapurna

A process for the preparation of a novel iridoide fraction having immunorestorative activity from the plant of *Picrorhiza kurroa*.

No.845/DEL/92
dated 22.9.92

Taneja, S.C.
Sethi, V.K.
Dhar, K.L.
Kapil, R.S.

A process for the preparation of novel acylates of boswellic acids useful as anti-inflammatory & antiarthritic agents.

No.1076/DEL/92
dated 20.11.92

Taneja, S.C.
Sethi, V.K.
Anand, A.S.
Dhar, K.L.
Kapil, A.

A process for the preparation of 3-epi- β -boswellic acid and its acylates useful as antiinflammatory and antiarthritic

No.1077/DEL/92
dated 20.11.92

Taneja, S.C.
Sethi, V.K.
Anand, A.S.
Dhar, K.L.
Kapil,,A.

A process for the preparation of 3-epi-11-keto-B-boswellic acids and its acylates,,useful as anti-inflammatory and antiarthritic agents.

No.1078/DEL/92
dated 20.11.92

SPONSORED PROJECTS

Technology transfer of bioavailability enhancer AT-3

M/S Cadila Laboratories
Ahemedabad

CONSULTANCY

Agrotechnology of hops	All India Brewer's Association, Bangalore.
Agrotechnology of Lemon grass RRL-16	I. M/S Hindustan Lever Ltd. Bari Brahmana, Jammu. II. Project Officer Minor Forest Products Jammu.
Agrotechnology of Jamrosa	Project Officer Minor Forest Products Jammu
Agrotechnology of Dioscorea	Project Officer Minor Forest Products Jammu
Cultivation of Hops	Dewan Modern Breweries Jammu
Project report for fibre board	Belglass Boards Pvt. Ltd. Ludhiana.
Distillation still for multipurpose es- sential oil unit	Himalayan Extracts (P) Ltd. Chandigarh
Bolder crystals of menthol	Pankaj Chawla & Arun Bajaj New Delhi
Extension work on hops	Director of Horticulture Shimla

IMPORTANT ACTIVITIES

I. Scientific

The tenth meeting of TAB Project on "Commercial exploitation of *Cymbopogon* species", was held on 15 & 16 June 1992, which was Chaired by our Director. It was attended by Project coordinator of CIMAP and concerned scientists of RRL Jammu, CIMAP, Lucknow and RRL Bhubaneswar. In this meeting full assessment of work done on *Cymbopogon* was done and future programme was chalked out to increase its production.

Training and Demonstration

a) Under CSIR rural development programme

The following training courses were conducted in Jammu Division under this programme.

i) Preservation of tomato products

23-24 Feb., 1993

At Chenani (District Udhampur)

ii) Economic utilisation of citrus waste

26-27 Feb, 1993

At Pouni (District Udhampur)

iii) Cultivation and processing of mushrooms

1 March, 1993

At Jib (Distt. Udhampur)

17-19 March, 1993

At Shibuchak Tehsil Bishnah (Distt. Jammu)

iv) Improved aquaculture techniques

2-4 March, 1993

At Satura (Distt. Kathua)

(b) Rearing of ornamental fish

A five day training programme/workshop was organised from 22 to 27 June, 1992 regarding rearing of ornamental fish and fabrication of aquariums.

c) Bharatia Jan Gyan Vigyan Jetha-92

Details are mentioned under National Mission Projects.

d) On Hops

A short term training course on cultivation and post harvest processing of hops was organised in Lahaul Valley in August 1992. The field demonstrations on improved agrotechniques were held in five villages -Sumnam, Keylong, Rapey, Jobrang and Rashal and trainees were provided free literature on hops.

(e) Chemical engineering & design

Our laboratory imparted two months practical training to two undergraduates of BITS, Pilani in various units of Chemical Engineering & Design Division.

f) On Water Quality Awareness

Dr.S.K.Mehta delivered a lecture on water quality awareness in Bhartia Jan Gyan Vigyan Jetha-92, held at RRL Jammu from 13-17 Oct.,1992.

II. Others

A) CSIR Foundation Day

As usual ,26th Sept. 1992 was celebrated as CSIR Foundation Day. Following activities were organised in this connection.

a) Open Day

(i) Students meet Scientists

This was year's main theme and over 1200 students of different educational Institutes interacted with the scientists .

(ii) Entrepreneurs meet Scientists

A large number of entrepreneurs and industrialists visited the Laboratory to acquaint themselves with the on going activities.

(iii) Inauguration of Anardana Processing Machine

Shri. Amit Kushari, Commissioner/Secretary, Science and Technology inaugurated this Machine which has been developed by the Scientists and Engineers of our Laboratory.

(b) Foundation Day Function

1. Presentation of mementos and prizes

(i) This day marked the conclusion of year long Golden Jubilee celebrations. On this occasion gold plated silver coins were presented to all the 620 regular employees.

(ii) Wrist watches to 16 staff members who had completed 30 years of service in CSIR.

(iii) Wall clocks to 15 ex-employees who had superannuated during the past 12 months.

(iv) The prizes were given to the winner of essay competition (17 children).

(v) Two prizes were given to the winners of science Quiz.

(B) RRL Foundation Day

RRL, Jammu celebrated its Foundation Day on December 1, 1992. The main highlights of the Function were:-

I) Foundation Day Lecture by Chief Guest Dr. S. Varadarajan on - "Challenges in Technological Opportunities".

II) Release of linalool rich variety of *Ocimum canum*

III) Release of booklet.

(C) National Unity Week

It was celebrated from November 19-25, 1992. The main activities organised during the week consisted of:

I) National Integration Pledge on November 19, 1992.

II) A fraternal procession (Prabhat Pheri) on November 20, 1992.

III) Linguistic Harmony Day was celebrated on November 21, 1992 by organising a multilingual "Kavi Sammalen".

IV) Cultural Unity Day was celebrated on November 23, 1992 with a cultural programme by the children.

V) Womens Day was observed on November 24, 1992.

VI) Conservation Day was observed on November 25, 1992 and special drive was made to keep environment and Laboratory colony clean.

HONOURS AND AWARDS

(a) Nominations

Dr. B.L. Bradu and Dr.M.K . Khosla have been elected as members of Executive Council of the Essential Oil Association of India for the term 1993-1995.

Dr. J.S. Chawala has been nominated as member of the following:

- i) Council of Association (Governing body) and Research and Advisory Council Central Pulp & Paper Research Institute, Saharanpur.
- ii) Programme advisory Council, Indian Industries Research and Training Institute, Bangalore.

(b) Recognition as Research Guide

Dr. M.K. Khosla has been approved Supervisor to guide research leading to the award of Ph.D. degree in Botany, by the University of Jammu.

Dr. M.L.Sharma has been approved supervisor to guide research leading to award of Ph.D. degree in Zoology, by the University of Jammu.

(c) Award of Ph.D.Degree

Khajuria, R.K. - Synthetic modifications of quinones and synthesis of some nitrogen heterocycles as biologically active compounds; University of Jammu; Supervisor - Dr. K.L.Dhar, Scientist-F and Dr.S.M.Jain, Scientist EII, RRL, Jammu.

VISIT ABROAD

Dr. V.Verma, Scientist C, visited Germany from 3 May 1991 to 28 July 1992 to work with Prof. (Dr.) John Cullum at L. B. Genetik University of Kaiserslautern. During his stay he worked on various aspects of *Micrococcus* strain and keto acid producing strain of *Gluconobacter oxydans*.

Dr. S.G. Agarwal, Scientist EI visited Czechoslovakia from 6 March to 10 May, 1992 under CSIR-CSAV Exchange Programme. During his stay he worked in the Institute of Organic Chemistry and Biochemistry, Praha and studied the effect of C-17 substituents on stereochemistry of hydrogenation of 4,5 double bond in androstane and epiandrostanes. He also synthesised new compounds and studied their reaction mechanisms.

Dr. Jagdev Singh, Scientist EII visited Vietnam from 10 April to 11 May 1992 on UNDP assignment under Project No.- DP/VIE/85/ 001/11-57/J,3420 under subcontract through NRDC for the pilot production of edible dye bixin from *Bixa orellana* seeds and non-edible leuco- dye from *Diospyros mollis* fruits . He worked in Ho Chi Minh city of Vietnam.

Sh. Y.P. Talwar, Scientist C, visited Vietnam under UNDP assignment from 3 March to 5 April, 1992 for the production of bolder crystals of menthol. He worked at Hanoi city of Vietnam.

Dr. Y.S. Bedi, Scientist C, visited Germany from 20 September to 19 December, 1992 under INSA-DFG Exchange Programme. He worked with Prof. (Dr.) Rolf Schelgel at Institute of Genetics and Crop Plant Research, Gatersleben. He undertook training in advanced chromosome mediated transfer of alien chromosomes for raising transgenic plant. He also acquired germplasm on *Taxus* species.

Dr. Gandhi Ram, Scientist C, visited Poland under CSIR-PAS Exchange Programme from 10 August to 4 October, 1992. During his stay he studied the latest developments and methodologies in the field of plant breeding especially mutation breeding in medicinal, aromatic and economic plants at Agricultural University, Warsaw.

Dr. Bupinder Singh, Scientist C, visited Poland under CSIR-PAS Exchange Programme from 2-31 October 1992. During his stay he acquired knowledge of latest techniques used in the investigation of compounds for CNS, anti-inflammatory and hepatoprotective activities. He also delivered two lectures at Warsaw and Krakow.

Dr. (Ms.) Rashmeet Reen, technical assistant, visited Germany under sandwich programme of DAAD from 5 June, 1991 to 24 December, 1992 and worked with Prof. (Dr.) F.J.Wiebel at GSF Institute of Toxicologie in Munich. During her stay she studied the biochemical effect of piperine in Mammalian cell culture.

Following scientists and technicians visited Vietnam to commission Natural Dyes & Pigment plant at Ho Chi Minh city.

Dr.S.M. Jain, Scientist-EII (10 April to 9 May)

Sh. Dilbagh Singh Sehra, Mech. Asstt. (15 March to 14 April 1992)

Sh. Gulshan Kumar, Electrician (15 March to 14 April 1992).

SALE/DISTRIBUTION OF PROPAGATING MATERIALS

1. Slips	
Lemon grass	1,26,000
Jamrosa	17,000
2. Seed	
<i>Ocimum canum</i>	16.30 Kg
<i>Solanum khasianum</i>	4 Kg
Clocimum	300 Gm
3. Mushroom Spawn	295 bottles

SALE OF RESEARCH PRODUCE

Rats (Laboratory white)	1126 Nos.
<i>Essential Oils of</i>	
Lemon grass	79.7 kg
Jamrosa	79.1 kg
Celery	2.5 kg
Palmarosa	14.7 kg
Teasel heads	3700 Nos.
Dried Eucalyptus Leaves	60 Quintal
Fresh fire wood	376 tonnes

SERVICE RENDERED TO PRIVATE PARTIES

Distillation of CKP-25 lemon grass	168 kg
Testing of water samples	150 Nos.
Testing of samples of limestone, acids, zinc metal alloy, alum, dolomite, plaster of Paris and bleaching powder	70 Nos.

STAFF

As on 31.3.1993

Dr.R.S.Kapil
DIRECTOR

SCIENTIST G

DR. C.L.CHOPRA

SCIENTIST F

DR.K.L. DHAR

DR. S.K. MEHTA

DR. J.S. CHAWLA

DR. Y.K. SARIN

SCIENTIST EII

PROF. K.K.KAPUR

DR. B.L.KAUL

DR. S.K.BANERJEE

DR. A.K.RISHI

DR. JAGDEV SINGH

DR. G.N.QAZI

DR. B.L.RAINA

DR. R.N.THAKUR

DR. K.K.ANAND

DR. S.M.JAIN

DR. V.B.PANDOTRA

SCIENTIST EI

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SH. R.P.SINGH

DR. RAMESH KAPOOR

R. SWADESH PAL

SH. D.V.RAWAL
SH. B.M.GANDOTRA

SCIENTIST C

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SH. F.C.GUPTA
SH. C. NAINAR
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DR. (SMT) A. KAPIL
DR. (SMT) P. SOMAL
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